General Specifications

Item	Specification
Fluid [a]	
Motorcraft MERCON® V Transmission Fluid XT-5-QM	MERCON®V
Fluid Capacities	
3.8L engine	13.2L (13.9 quarts)
4.6L engine	12.0L (12.8 quarts)
Fluid Filter	
Inline Transmission Fluid Filter Kit	XC3Z-7B155-AA
Inline Transmission Fluid Filter	XC3Z-7B155-BA
Lubricant	
Ford Multi-Purpose Grease D0AZ-19584-AA	ESB-M1C93-B

[a] MERCON® V is not interchangeable at this time with the current MERCON® fluids. Check the transmission fluid level indicator to determine the correct fluid and refer to the Workshop/Owner publication to determine the correct service interval for the specific vehicle.

Torque Converter End Play

Item	Specification
New or remanufactured	0.355-1.04 mm (0.014-0.074 in)
Used	0.355-1.87 mm (0.014-0.074 in)

Band and Clutch Application Chart

Gear	Overdrive Band	Low Reverse Band	Forward Clutch	Direct Clutch	Interm Friction Clutch	Reverse Clutch	Interm One-Way Clutch	Planetary One-Way Clutch
1st Gear Manual Low		A	A					H
2nd Gear Manual Low	A		A		A		H	
1st Gear — (D) (Overdrive)			A					H
2nd Gear — (D) (Overdrive)			A		A		H	
3rd Gear — (D) (Overdrive)			A	A	A		O/R	
4th Gear — (D)	A			A	A		O/R	

(Overdrive)								
Reverse (R)		A				A		
Park Engine Running		A						

A = Applied

H = Holding

O/R = Overrunning

Stall Speed

Application	Min.	Max.
3.8L engine	2,240	2,619
4.6L 2V engine	2,339	2,738
4.6L 4V MACH 1 engine	2,375	2,767

Shift Speeds 4.6L 4V MACH 1 (3.55:1 Axle Ratio)

Throttle Position	Shift	MPH	Km/H
Light throttle	1-2	10-14	16-23
TP voltage	2-3	18-22	29-35
1.25 volts	3-4	34-37	55-60
Closed throttle	4-3	22-25	35-40
	3-2	12-16	19-26
	2-1	11-7	18-11
Wide open throttle	1-2	36-44	58-71
	2-3	75-83	121-134
	3-2	70	113
	2-1	33	53

Shift Speeds 4.6L 2V HO (3:27:1 Axle Ratio)

Throttle Position	Shift	MPH	Km/H
Light throttle	1-2	9-12	14-19
TP voltage	2-3	14-18	23-29
1.25 volts	3-4	36-38	58-61
Closed throttle	4-3	26-22	42-35
	3-2	15-11	24-18
	2-1	12-8	19-13
Wide open throttle	1-2	29-44	47-71

	2-3	74-80	119-129
	3-2	73	117
	2-1	32	51

Shift Speeds 3.8L (3:27:1 Axle Ratio)

Throttle Position	Shift	MPH	Km/H
Light throttle	1-2	6-10	10-16
TP voltage	2-3	18-22	29-35
1.25 volts	3-4	28–30	45–48
Closed throttle	4-3	24-22	39-35
	3-2	14-12	22-19
	2-1	6-8	10-13
Wide open throttle	1-2	36-40	58-64
	2-3	74-70	119-112
	3-2	67	108
	2-1	28	45

Shift Speeds 3.8L (3:08:1 Axle Ratio)

Throttle Position	Shift	MPH	Km/H
Light throttle	1-2	6-10	10-16
TP voltage	2-3	16-20	26-32
1.25 volts	3-4	38-42	61-68
Closed throttle	4-3	34-28	55-45
	3-2	16-13	26-21
	2-1	9-7	14-11
Wide open throttle	1-2	38-45	61-72
	2-3	72-76	116-122
	3-2	71	114
	2-1	31	50

Sensor Resistance Readings

Component	Resistance (ohms)
SSA	20-30
SSB	20-30
EPC	2.48-5.66
TCC	10-16
OSS	1,026-1,194

Selective Thrust Washer No.1

Item	Specification	
	mm	inch
Green thickness	1.217-1.371	0.050-0.054
Yellow thickness	1.727-1.828	0.068-0.072
Natural thickness	2.159-2.260	0.085-0.089
Red thickness	2.590-2.692	0.102-0.106
Blue thickness	3.022-3.124	0.119-0.123

Forward Clutch Pack

Item	Specification	
	mm	inch
Clearance	1.17-1.63	0.046-0.068
Snap ring thickness	1.524-1.625	0.060-0.064
	1.880-1.981	0.074-0.078
	2.235-2.337	0.088-0.092
	2.591-2.692	0.102-0.106

Reverse Clutch Pack

Item	Specification	
	mm	inch
Clearance	1.27-1.94 mm	(0.050-0.076 in)
Snap ring thickness	1.524-1.625	0.060-0.064
	1.880-1.981	0.074-0.078
	2.235-2.337	0.088-0.092
	2.591-2.692	0.102-0.106

Direct Clutch Pack

Item	Specification	
	mm	inch
Clearance	1.5748-21.59	0.062-0.85
Snap ring thickness	1.270-1.372	0.050-0.054
	1.625-1.727	0.064-0.068
	1.98,1-2.083	0.078-0.082
	2.337-2.438	0.092-0.096

Intermediate Clutch Pack

Item	Specification	
	mm	inch

Clearance	41.7322-42.5958	1.643-1.677
Selective steel plate	1.702-1.803	0.067-0.071
	1.956-2.057	0.077-0.081
	2.210-2.311	0.087-0.091
	2.464-2.565	0.097-0.101

Torque Specifications

Description	Nm	lb-ft	lb-in
Rear transmission support crossmember bolts	55	40	—
Rear insulator bolts	80	59	—
Extension housing bolts	28	21	—
Transmission fluid pan bolts	14	10	—
Front pump bolts	27	20	—
Front pump support bolts	23	17	—
Harness electrical connector bolt	5	—	44
Inspection cover bolts	35	26	—
Main control valve body bolts	10	—	89
Main control valve body cover plate bolts	10	—	89
Main control valve body separator plate bolts	10	—	89
Manual lever shaft nut	33	24	—
Manual lever shaft outer nut	33	24	—
Fluid cooler line case fittings	21	15	—
Pressure tap plugs	12	9	—
Rear driveshaft bolts	112	83	—
Starter bolts	25	18	—
TCC solenoid bolt	10	—	89
Torque converter drain plug	12	9	—
Torque converter nuts	37	27	—
Digital transmission range (TR) sensor bolts	9	—	80
Transmission bell housing bolts	47	35	—
Vehicle speed sensor (VSS) plug bolt	9	—	80
Output shaft speed (OSS) sensor bolt	12	9	—
Starter B+ cable	11	8	—
Exhaust manifold bolts	40	30	—
Exhaust pipe bolts	40	30	—
Transmission vent tube	12	9	—
Manual control valve detent lever spring bolt	10	—	89
Cooler tube nut to case fitting	18	13	—
Rear differential retaining nuts (front)	90	66	—
Rear differential retaining bolts and nuts (rear)	70	52	—

Transmission linkage	23	17	—
Shift cable bracket	14	10	—
Transmission test plate bolts	10	—	89

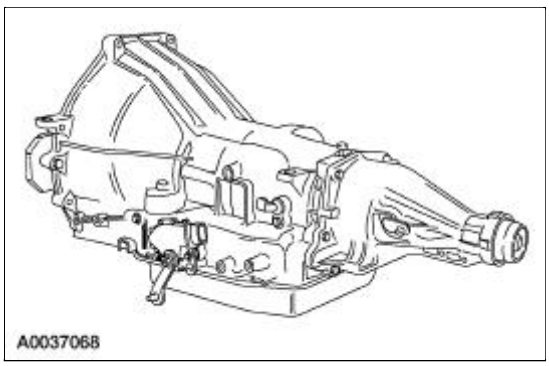
Transmission Description

The 4R70W has the following features:

- Wide ratio gears
- Four speeds
- Rear wheel drive
- Automatic
- Electronic shift
- Torque converter clutch control
- Line pressure controls

The transmission uses Ravigneaux-style double-pinion gearset with two bands, one one-way roller clutch, one mechanical diode and four friction clutches to produce four forward gears and Reverse.

4R70W Automatic Transmission

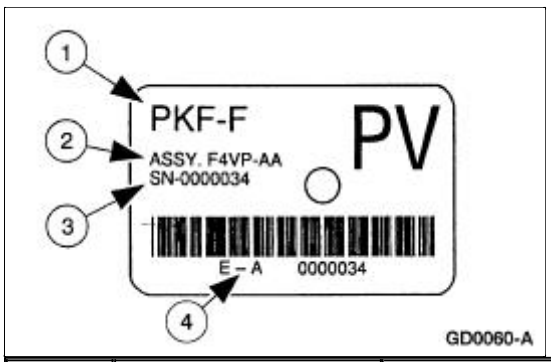


Identification Tags

All vehicles are equipped with a Vehicle Certification Label, located on the driver side door lock post. For correct transmission identification, refer to the code in the space marked TR.

For model, service ID level or build date information, refer to the transmission service ID tag located on the transmission case.

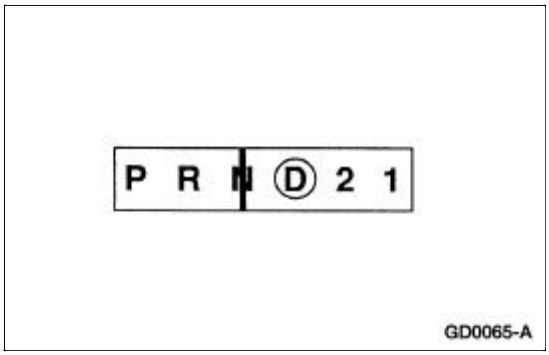
Identification Tag



Item	Part Number	Description
1	—	Model number
2	—	Assembly number
3	—	Serial number
4	—	Model and serial number

Range Selection

The transmission has six range positions: P, R, N, (D), 2 and 1.



Park

In the PARK position:

- there is no powerflow through the transmission.
- the parking pawl locks the output shaft to the case.
- the engine can be started.
- the ignition key can be removed.

Reverse

In the REVERSE position:

- the vehicle can be operated in a rearward direction, at a reduced gear ratio.
- engine braking will occur.

Neutral

In the NEUTRAL position:

- there is no powerflow through the transmission.
- the output shaft is not held and is free to turn.
- the engine can be started.

Overdrive

Overdrive is the normal position for most forward driving.

The OVERDRIVE position provides:

- Automatic shifts.

- Apply and release of the torque converter clutch.
- Maximum fuel economy during normal operation.

Second Position

This position provides:

- Second gear start and hold.
- The torque converter clutch can apply and release.
- Improved traction and engine braking on slippery roads.
- Engine braking for descending steep grades.

First Position

If this position is selected at normal road speeds, the transmission will shift into second gear, then into first when the vehicle reaches a speed below approximately 45 km/h (28 mph).

This position provides:

- First gear operation only.
- Engine braking for descending steep grades.

Shift Patterns

Upshifts

Transmission upshifting is controlled by the powertrain control module (PCM). The PCM receives inputs from various engine or vehicle sensors and driver demands to control shift scheduling, shift feel and torque converter clutch (TCC) operation.

Downshifts

Under certain conditions the transmission will downshift automatically to a lower gear range (without moving the gearshift lever). There are three categories of automatic downshifts; Coastdown, Torque Demand and Forced or Kickdown shifts.

Coastdown

The coastdown downshift occurs when the vehicle is coasting down to a stop.

Torque Demand

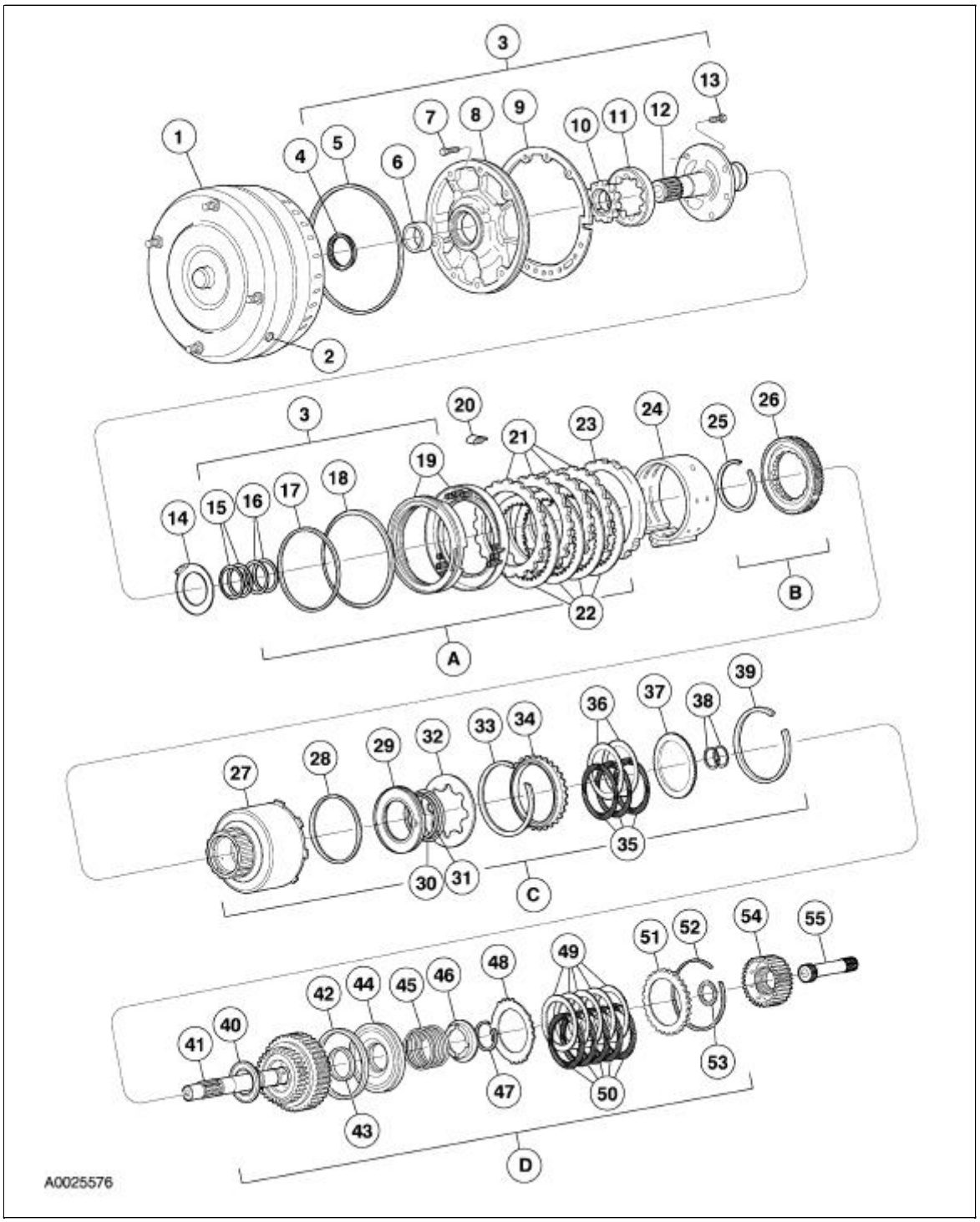
The torque demand downshift occurs (automatically) during part throttle acceleration when the demand for torque is greater than the engine can provide at that gear ratio. If applied, the transmission will disengage the TCC to provide added acceleration.

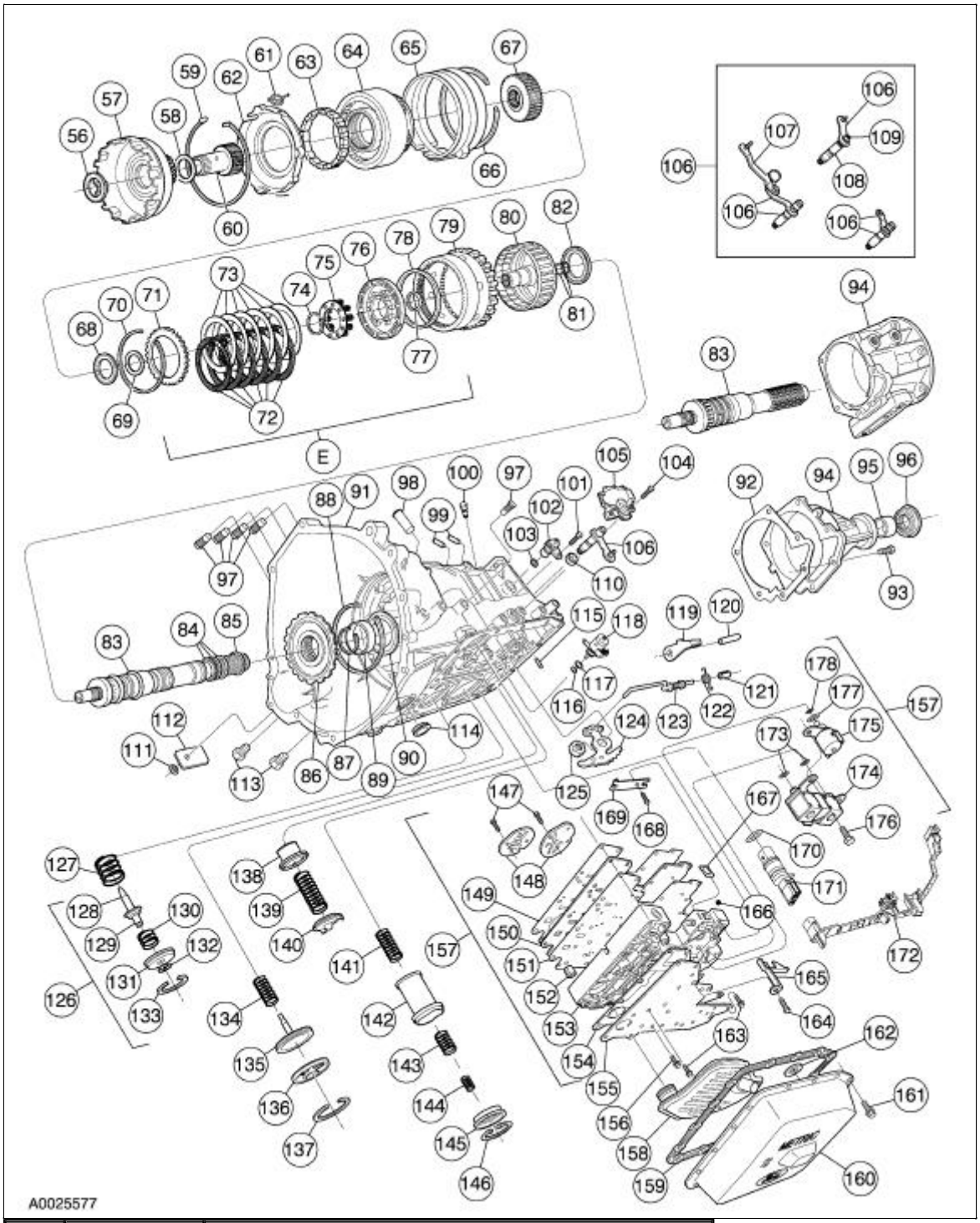
Kickdown

For maximum acceleration, the driver can force a downshift by pressing the accelerator pedal to the floor. A forced downshift into a lower gear is possible below calibrated speeds. Specifications for downshift speeds are subject to variations due to tire size, engine and transmission calibration requirements.

Disassembled Views

4R70W Automatic Transmission — Disassembled View





Item	Part Number	Description
1	7902	Converter assembly (model dependent)
2	391855-S100	Plug — converter drain — 1/8-27 Dryseal (model dependent)
3	7A103	Pump assembly — front
4	7A248	Seal assembly — front pump
5	7A248	Seal — front pump
6	7B258	Bushing — front pump
7	N605789-S100	Bolt — M8-1.25 x 35 hex head (7-attaches 7A103 to 7005)

8	7A106	Body assembly — front pump (part of 7A103)
9	7A136	Gasket — front pump
10	7H169	Gear — pump inner gerotor (part of 7A103)
11	7H169	Gear — pump outer gerotor (part of 7A103)
12	7A108	Support assembly — front pump
13	N605787-S	Bolt — M8-1.25 x 25 hex flange head (5-attaches 7A108 to 7A103)
14	7D014	Washer — front pump support thrust — select fit No. 1
15	7D020	Seals — reverse clutch cylinder (2 req'd)
16	7D019	Seals — forward clutch cylinder (2 req'd)
17	7F225	Seal — intermediate clutch piston inner
18	7F224	Seal — intermediate clutch piston outer
19	7E005	Piston kit — intermediate clutch
20	7A609	Intermediate clutch anti-rattle clip (model dependent)
21	7B442	Plate — intermediate clutch external spline (select fit) (steel)
22	7B164	Plate assembly — intermediate clutch internal spline (friction)
23	7B066	Plate — intermediate clutch pressure
24	7F196	Band assembly — overdrive
25	391267-S	Ring —3-21/64 retains type SU external (retains 7F262 to 7F215)
26	7F271	Clutch assembly —intermediate one-way clutch
27	7D044	Drum assembly — reverse clutch
28	7D403	Seal — reverse clutch piston outer
29	7D402	Piston assembly — reverse clutch
30	7D404	Seal reverse clutch piston inner
31	7D256	Ring — reverse clutch piston pressure
32	7B070	Spring — reverse clutch piston return
33	7A577	Spring — reverse clutch piston spring
34	7B066	Plate — reverse clutch front pressure
35	7B164	Plate — reverse clutch internal spline (friction)
36	7B442	Plate — reverse clutch external spline (steel)
37	7B066	Plate — reverse clutch rear pressure
38	7B497	Seals — input shaft (2 req'd)
39	7D483	Retainer — reverse clutch pressure plate — (select fit)
40	7A166	Bearing and race assembly — forward clutch No. 2
41	7F207	Cylinder and input shaft assembly — forward clutch
42	7A548	Seal — forward clutch piston outer

43	7C099	Seal — forward clutch piston inner
44	7A262	Piston — forward clutch
45	7A480	Spring — forward clutch piston return
46	7A527	Retainer return spring — forward clutch
47	388099-S	Snap ring — retaining — 1-59/64 (retains 7A529 in 7F207)
48	7E085	Spring — rear clutch pressure plate (model dependent)
49	7B442	Plate — forward clutch external spline (steel)
50	7B164	Plate — forward clutch internal spline (friction)
51	7B066	Plate — forward clutch pressure
52	7D483	Snap ring — retaining (select fit)
53	7F231	Bearing and race assembly — forward clutch front No. 3
54	7B067	Hub — forward clutch
55	7F351	Shaft — intermediate stub
56	7C096	Bearing and race assembly — forward clutch hub No. 4
57	7A019	Gear assembly — reverse sun
58	7F244	Bearing and race assembly — forward clutch sun gear No. 5
59	388501-S	Retaining ring — center support — 7-7/92
60	7A399	Gear assembly — forward clutch sun
61	7F277	Spring — case to planet support
62	7A130	Support assembly — planetary gear
63	7A089	OWC cage spring and roller assembly — planetary
64	7A398	Planetary assembly (model dependent)
65	7D095	Band assembly — reverse
66	377437-S	Retaining ring — 0.58 thick (locates reverse band during assembly)
67	7F236	Hub — direct clutch
68	7F243	Bearing and race assembly — direct clutch inner No. 7
69	7F237	Support — direct clutch inner bearing
70	7D483	Retaining ring — direct clutch pressure plate (select fit)
71	7B066	Plate — direct clutch pressure
72	7B164	Plate — direct clutch internal spline (friction)
73	7B442	Plate — direct clutch external spline (steel)
74	388104-S	Retainer ring — 1-19/32 (retains 7F235 to 7F283)
75	7F235	Retainer and spring assembly — direct clutch
76	7A262	Piston assembly — direct clutch
77	7C099	Seal — direct clutch piston inner

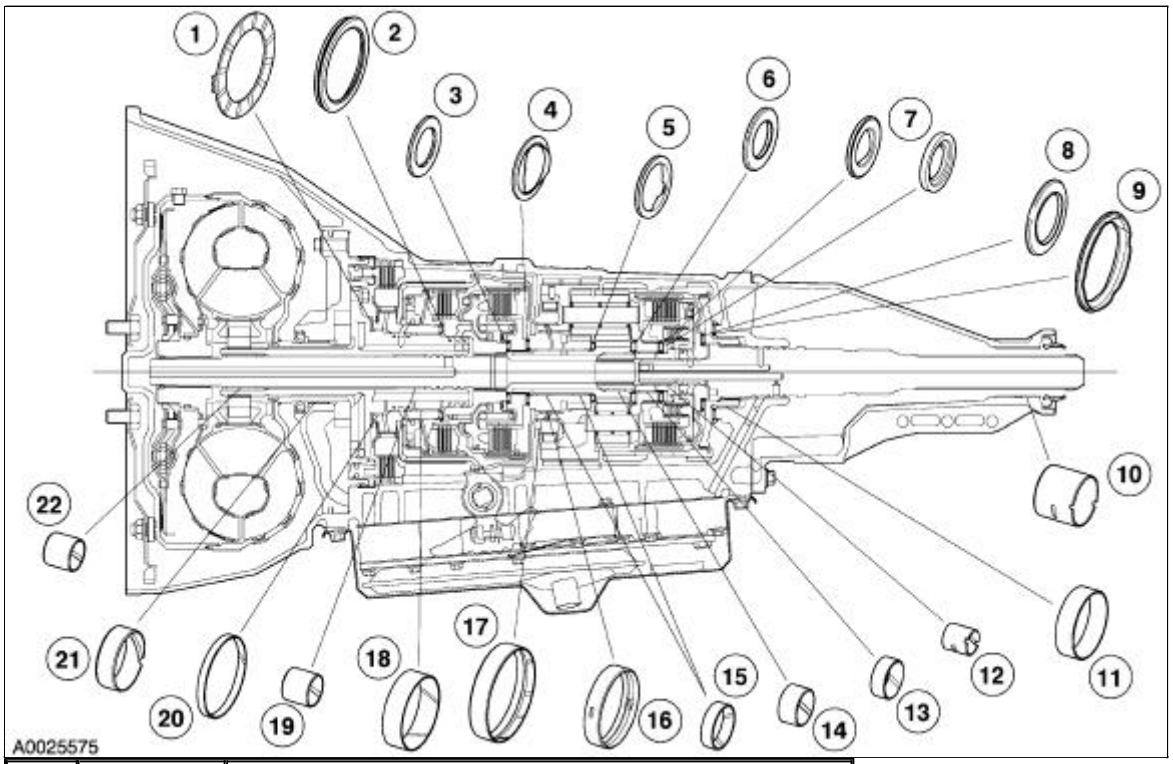
78	7A233	Seal — direct clutch piston outer
79	7A153	Gear — output shaft ring
80	7F283	Cylinder assembly — direct clutch
81	7F274	Seals — output shaft small — direct clutch (2 req'd)
82	7F240	Bearing and race assembly — direct clutch outer No. 8
83	7060	Shaft assembly — output (model dependent)
84	7F273	Seal — output to case shaft large (3 req'd)
85	87054-S94	Seal — O-ring (piloted output shaft only) (model dependent)
86	7D164	Hub — output shaft
87	97713-S	Snap ring — 1-13/16 retaining (retains 7D164 to 7060)
88	7C122	Snap ring — retaining (retains 7D164 to 7A153)
89	7025	Bushing — rear case
90	7F242	Bearing and race assembly — case rear No. 9
91	7005	Case assembly
92	7086	Gasket — extension (model dependent)
93	N803747-S1101	Bolt — M8-1.25 x 30 (6-attaches 7A039 to 7005) (model dependent)
94	7A039	Extension housing assembly (model dependent)
95	—	Bushing — extension housing (part of 7A039)
96	7052	Seal assembly — extension housing (model dependent)
97	390318-S100	Pipe plug — 1/8-27 Dryseal tapered (5 req'd)
98	7F295	Pin — overdrive band anchor
99	388142-S	Pin — reverse band anchor (part of 7005)
100	7034	Vent assembly — case
101	N605771-S427	Bolt — M6-1.0 x 14 hex head (attaches output shaft speed sensor to case)
102	7H103	Sensor assembly — transmission output shaft speed
103	N811757-S100	Seal — 14.0 x 1.78 O-ring (2 req'd)
104	N806933-S102	Bolt and washer assembly — M6-1.0 x 25 mm (1 in) (2-attaches 7F293 to 7005) (model dependent)
105	7F293	Sensor — transmission range
106	7A256	Lever assembly — manual control (model dependent)
107	7H296	Link assembly — manual control (model dependent)
108	7C493	Shaft — transmission manual control lever (model dependent)
109	N808737-	Nut — M10-1.5 (attaches 7A256 to 7C493)

	S427	
110	7B498	Seal assembly — manual control lever
111	373907-S2	Nut — 1/4 spring (retains identification tag to 7000)
112	7B148	Tag — identification (part of 7005)
113	7D273	Connector assembly — fluid tube (2 req'd)
114	7N171	Plug — converter housing access
115	7B210	Pin — manual lever shaft retainer
116	391131	Seal — 0.426 x 0.070 O-ring
117	N805862-S	Seal — 14.0 x 1.78 O-ring
118	7G383	Solenoid valve — transmission pressure control
119	7A441	Pawl — parking pawl
120	7D071	Shaft — parking pawl
121	7D419	Cup — park rod guide (part of 7A039)
122	7D070	Spring — parking pawl return
123	7A232	Rod assembly — park pawl actuating
124	7A115	Lever assembly — manual valve detent lever
125	N800287-S536	Nut — M14 x 1.5 hex intermediate detent lever (attaches 7A115 to 7A256)
126	7H188	Piston assembly — overdrive servo
127	7F201	Spring — overdrive servo piston
128	7F203	Rod — overdrive servo actuating (part of 7H188)
129	7H179	Washer — backup overdrive servo (part of 7H188)
130	7G277	Spring — overdrive cushion spring (part of 7H188)
131	7F200	Piston assembly — overdrive servo (part of 7H188)
132	97411-S	Ring — retaining (part of 7H188)
133	7384	Ring — 2.85 retaining type TVP "H" internal (retains 7H188 to 7005)
134	7D031	Spring — reverse band servo piston
135	7D189	Piston assembly — reverse band servo
136	7D036	Cover assembly — reverse band servo piston
137	388215-S100	Retaining ring internal — 3-13/16
138	7H292	Piston — 2-3 accumulator (bonded seals)
139	7F285	Spring — 2-3 shift accumulator piston (model dependent)
140	7B264	Retainer — 2-3 shift accumulator spring
141	7F284	Spring — 1-2 shift accumulator (model dependent)
142	7F251	Piston — 1-2 shift accumulator (bonded seals)
143	7F284	Spring — 1-2 shift accumulator

144	7G326	Nested spring — 1-2 (inner spring) (vehicle dependent)
145	7F247	Cover and seal assembly — 1-2 accumulator
146	7384	Ring — 2-1/16 retaining type HU internal (retains 7H300 to 7005)
147	N807178-S1000	Bolt — M6-1.0 x 18 hex head (12-attaches reinforcing plate to valve body)
148	7F282	Plate — valve body reinforcing (part of 7A100)
149	7C155	Gasket — valve body separator upper
150	7A008	Plate — control valve body separator (part of 7A100)
151	7D100	Gasket — valve body separator lower
152	7D174	Valve — converter drainback
153	7A091	Body assembly — main control
154	7H173	Gasket — valve body cover plate
155	7C034	Plate — valve body cover (part of 7A100)
156	N807178-S1000	Bolt — M6-1.0 x 18 hex head (11-attaches 7C034 to 7A100 (part of 7A100)
157	7A100	Control assembly — main (model dependent)
158	7A098	Filter and seal assembly — fluid
159	7A191	Gasket — transmission pan
160	7A194	Pan — transmission
161	N605785-S1036	Bolt — M8-1.25 x 18 hex flange head (14-attaches 7A194 to 7005)
162	7L027	Magnet — ceramic case (part of 7A194)
163	N808947-S1300	Bolt — M8-1.25 x 46 hex shoulder pilot (2-attaches 7C034 to 7A100)
164	N807179-S1000	Bolt — M6-1.0 x 52 hex flange head (12-attaches 7A100 to 7005)
165	7H111	Retainer — solenoid
166	7E195	Ball — 1/4 diameter coast booster valve shuttle (8 req'd)
167	7H187	Screen — solenoid pressure supply
168	N800670-S1000	Bolt — M6-1.0 x 40 hex flange head (13-attaches 7A100 to 7005)
169	7E332	Spring assembly — manual valve detent
170	7Z276	Seal — 0.864 x 0.070 O-ring (2 req'd)
171	7G276	Bulkhead assembly — wiring connector
172	7G276	Bulkhead assembly — connector (molded lead frame)
173	7Z484	Seal — 6.07 x 1.70 O-ring (2 req'd)
174	7G484	Solenoid valve — transmission shift
175	7G136	Solenoid valve — transmission torque converter clutch
176	N807178-S1000	Bolt — M6-1.0 x 16 hex head (retains 7D136 and 7G484 to 7A100)

177	7Z136	Seal — 0.489 x 0.070 O-ring
178	7Z484	Seal — 0.176 x 0.070 O-ring
A	—	Intermediate clutch assembly
B	—	Intermediate one-way clutch
C	—	Reverse clutch assembly
D	—	Forward clutch assembly
E	—	Direct clutch assembly

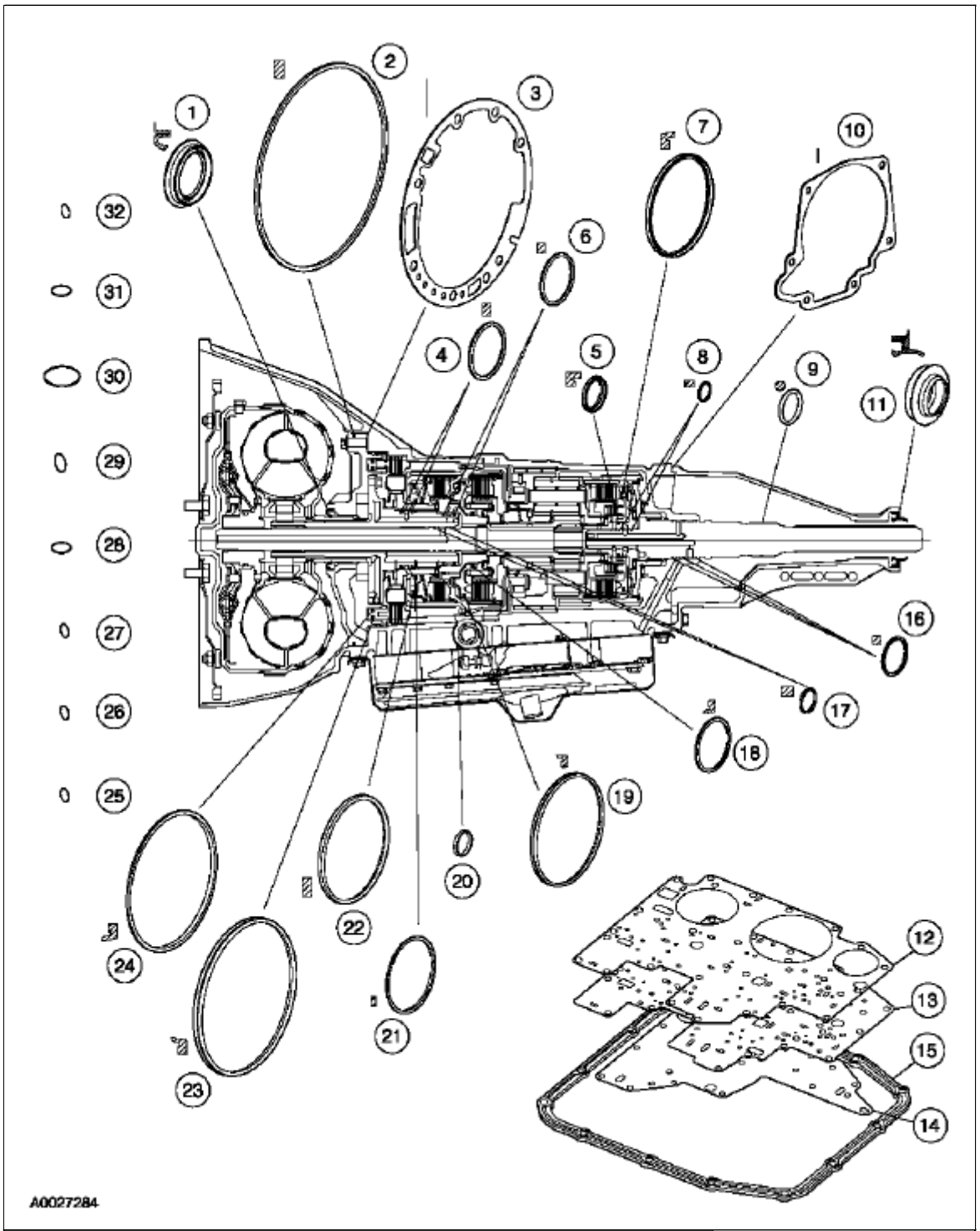
Bushings, Bearing and Thrust Washer Locator



Item	Part Number	Description
1	7D014	Pump No.1 thrust washer (select fit)
2	7A166	Forward clutch No. 2 bearing and race assembly
3	7F231	Forward clutch bearing and race assembly — front No. 3
4	7F244	Forward clutch hub bearing and race assembly No. 4
5	7F244	Forward clutch sun gear bearing and race assembly No. 5
6	7F241	Planet assembly bearing and race No. 6
7	7F243, 7F237	Direct clutch inner bearing, race assembly No. 7 and direct clutch inner bearing support No. 7
8	7F240	Direct clutch outer bearing and race assembly No. 8
9	7F242	Outer bearing and race assembly — rear No. 9
10	—	Extension bushing (part of 7A039)
11	7025	Case bushing
12	7B233	Output shaft bushing
13	7B375	Planet carrier bushing — rear
14	7F209	Forward clutch sun gear bushing
15	7N193	Reverse clutch sun gear bushing

16	7B374	Carrier bushing — front
17	7A132	Planetary support bushing
18	7F218	Reverse clutch drum bushing — rear
19	7B261	Front pump support bushing
20	7F217	Reverse clutch drum bushing — front
21	7B258	Front pump bushing
22	7B261	Front pump support bushing

Seals, Rings and Gasket Locator

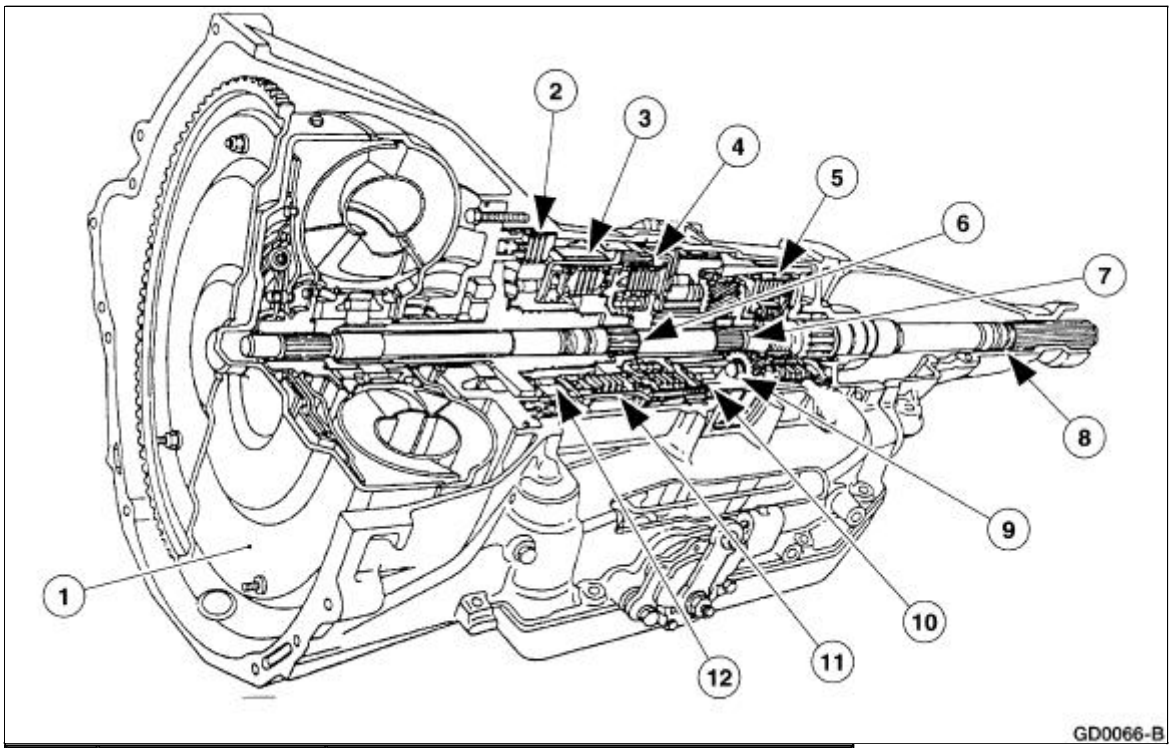


Item	Part Number	Description
1	7A248	Front pump seal assembly
2	7A248	Front pump seal
3	7A136	Front pump gasket

4	7D020	Reverse clutch cylinder seal (2 req'd)
5	7C099	Direct clutch piston inner seal
6	7D019	Forward clutch cylinder
7	7A548	Direct clutch piston outer seal
8	7F274	Output shaft to direct clutch cylinder seal (2 req'd)
9	87054-S94	O-ring seal (piloted) (model dependent)
10	7086	Extension gasket
11	7052	Extension housing seal assembly
12	7C155	Control valve body upper gasket
13	7D100	Valve body separator plate lower gasket
14	7H173	Valve body cover plate gasket
15	7A191	Transmission pan to case gasket
16	7F273	Output shaft to case seal (3 req'd)
17	7B497	Input shaft seal (2 req'd)
18	7C099	Forward clutch piston inner seal
19	7A548	Forward clutch piston outer seal
20	7B498	Manual control lever seal assembly
21	7D403	Reverse clutch piston outer seal
22	7D404	Reverse clutch piston inner seal
23	7F224	Intermediate clutch piston outer seal
24	7F225	Intermediate clutch piston inner seal
25	391308-S	Fill tube level indicator seal
26	7Z484	TCC solenoid seal (large)
27	7Z136	TCC solenoid seal (small)
28	7Z484	Shift solenoid seal (2 req'd)
29	N811757-S100	Output shaft speed sensor seal
30	7Z276	Bulkhead seal (1 req'd)
31	N805862-S	Pressure control solenoid seal (large)
32	391131	Pressure control solenoid seal (small)

Main Components and Functions

Transmission Main Components — Sectional View



Item	Part Number	Description
1	7902	Torque converter
2	7B164	Intermediate clutch (friction)
3	7B164	Reverse clutch (friction)
4	7B164	Forward clutch (friction)
5	7B164	Direct clutch (friction)
6	7F207	Forward clutch cylinder and shaft
7	7F351	Shaft — intermediate stub
8	7060	Output shaft
9	7A089	Planetary one-way clutch
10	7D095	Reverse clutch band
11	7F196	Overdrive band
12	7A089	Intermediate one-way clutch

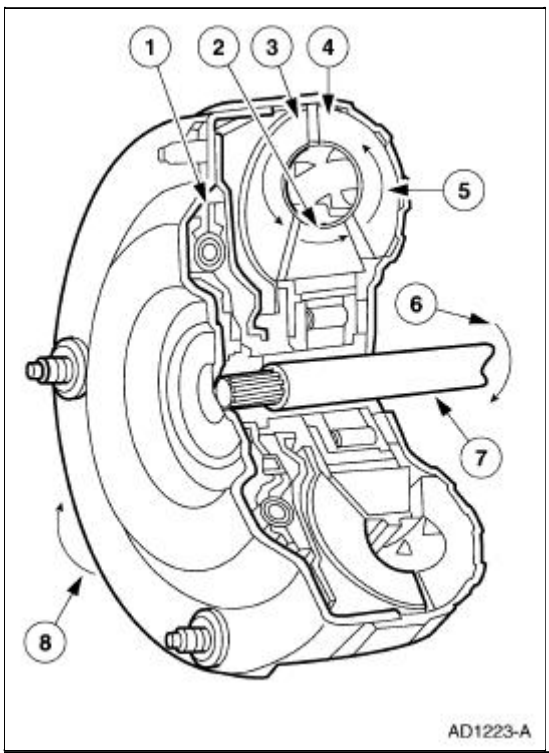
Torque Converter

The torque converter transmits and multiplies torque. The torque converter is a four-element device:

- impeller assembly
- turbine assembly
- reactor assembly
- clutch and damper assembly

The standard torque converter components operate as follows:

- Rotation of the converter housing and impeller set the fluid in motion.
- The turbine reacts to the fluid motion from the impeller, transferring rotation to the geartrain through the input shaft.
- The reactor redirects fluid going back into the impeller, allowing for torque multiplication.
- The clutch and damper assembly dampens powertrain torsional vibration and provides a direct mechanical connection for improved efficiency.
- Power is transmitted from the torque converter to the planetary gearsets and other components through the input shaft.



Item	Part Number	Description
1	—	Converter clutch and damper (part of 7902)
2	—	Reactor (part of 7902)
3	—	Turbine (part of 7902)

4	—	Impeller (part of 7902)
5	—	Fluid motion
6	—	Transmission input rotation
7	—	Input shaft
8	—	Engine rotation

Geartrain

Power is transmitted from the torque converter to the Ravigneaux geartrain components through the input shaft and forward clutch cylinder.

- The geartrain contains a Ravigneaux planetary set connected by dual pinion gears.
- By holding or driving certain components of the gearset, four forward ratios and one reverse ratio are obtained and transmitted to the output shaft. The ratios are as follows:

Gear Ratio	
1st	2.84 to 1
2nd	1.55 to 1
3rd	1.00 to 1
4th	0.70 to 1
Reverse	2.32 to 1

- Components of the geartrain can be held by bands or clutches and driven by clutches only.

The 4R70W uses:

- two bands.
- two one-way clutches (one roller, one mechanical diode).
- four friction clutches.

Planetary Gearset

The planetary gearset in the transmission is a Ravigneaux-type set consisting of the following components:

- forward clutch sun gear
- reverse clutch sun gear
- a pinion carrier
- long and short pinions
- output ring gear

Components are held or driven to produce forward and reverse gear ratios.

Input Shaft

The forward clutch cylinder and shaft transfers speed and torque from the converter turbine to the geartrain. This shaft is splined to the turbine on one end and to the forward clutch sun gear and stub shaft on the other end.

Stub Shaft

The stub shaft transfers power from the input shaft to the planet carrier (through the direct clutch) during third and fourth gear operation.

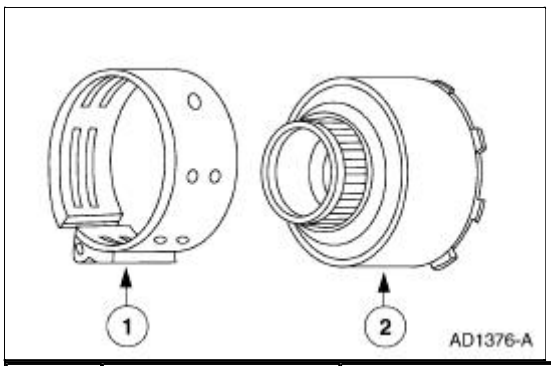
Output Shaft

The output shaft provides torque to the driveshaft and rear axle assembly. It is driven by the ring gear of the planetary gearset.

Apply Components

There are eight apply components used to drive or hold the planetary gearset components.

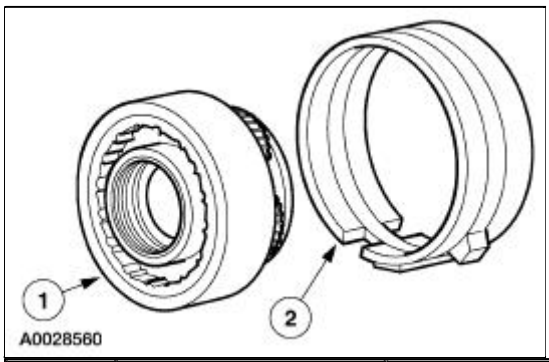
Band—Overdrive



Item	Part Number	Description
1	7F196	Overdrive band assembly
2	7D044	Reverse clutch drum assembly

The overdrive band holds the reverse clutch drum stationary in fourth gear and manual 2. This action causes the reverse sun gear to be held in these ranges.

Band—Low and Reverse

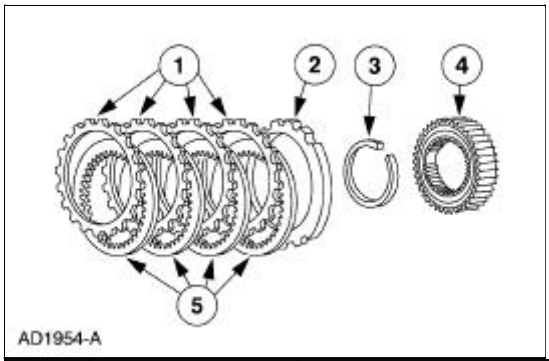


Item	Part Number	Description
1	7A398	Planetary assembly
2	7D095	Reverse band assembly

The low and reverse band holds the pinion carrier in reverse. The reverse band also applies in manual 1 position to provide engine braking.

Clutch—Intermediate

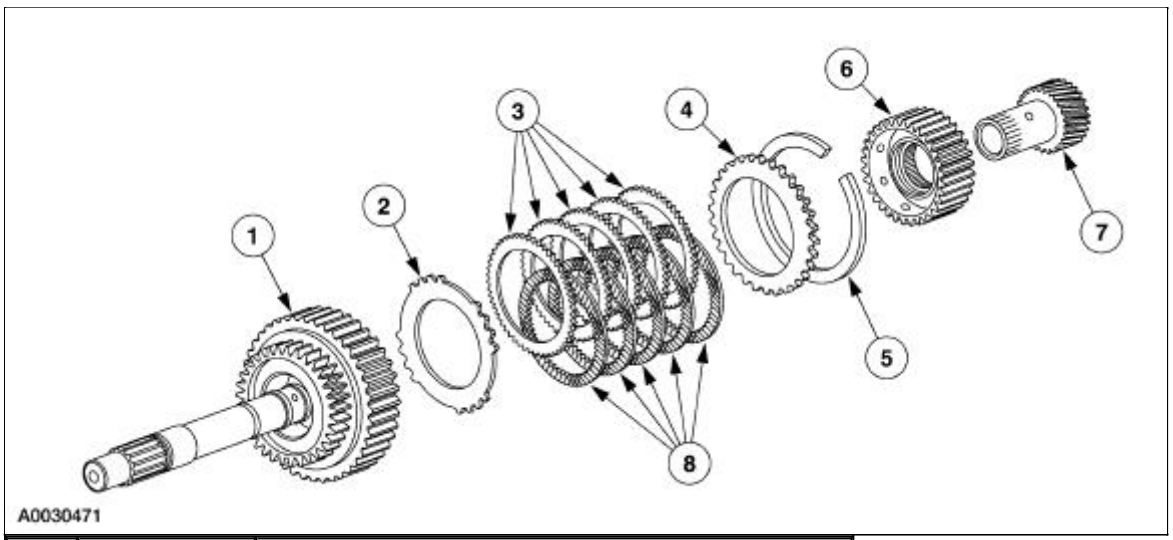
Intermediate Clutch Disassembled View



Item	Part Number	Description
1	7B442	Intermediate clutch plates (steel)
2	7B066	Intermediate clutch pressure plate
3	391267-S	Retaining ring
4	7A089	Intermediate one-way clutch assembly
5	7B164	Intermediate clutch plates (friction)

The intermediate clutch works with the intermediate one-way clutch to hold the reverse sun gear stationary in second gear. The intermediate clutch remains applied in third and fourth gears, but does not transmit power.

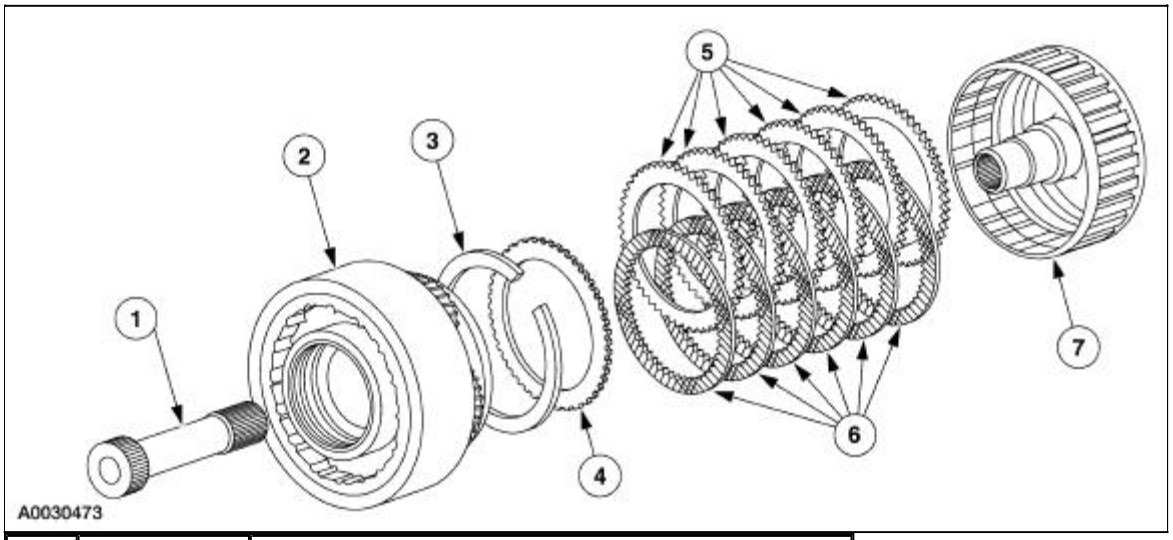
Clutch—Forward



Item	Part Number	Description
1	7F207	Forward clutch cylinder and input shaft assembly
2	7E085	Rear clutch pressure plate spring
3	7B442	Forward clutch plate external spline (steel)
4	7B066	Forward clutch pressure plate
5	7D483	Snap ring — retaining (select fit)
6	7B067	Forward clutch hub
7	7A399	Forward clutch sun gear assembly
8	7B164	Forward clutch plate internal spline (friction)

The forward clutch couples the forward clutch cylinder and input shaft to the forward sun gear in first, second, and third gears. The forward clutch is not applied in fourth gear.

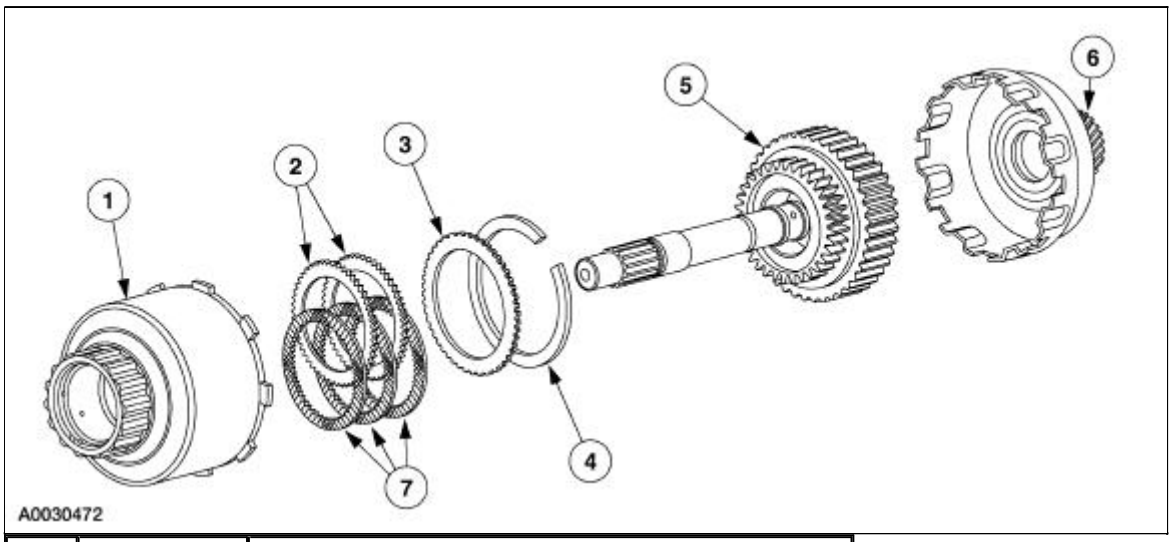
Clutch—Direct



Item	Part Number	Description
1	7F351	Intermediate stub shaft
2	7A398	Planetary assembly
3	7D483	Direct clutch pressure plate retaining ring (select fit)
4	7B066	Direct clutch pressure plate
5	7B442	Direct clutch plates external splined (steel)
6	7B164	Direct clutch plates internal splined (friction)
7	7F283	Direct clutch cylinder assembly

The direct clutch couples the input shaft to the planet carrier through the stub shaft in third and fourth gears.

Clutch—Reverse

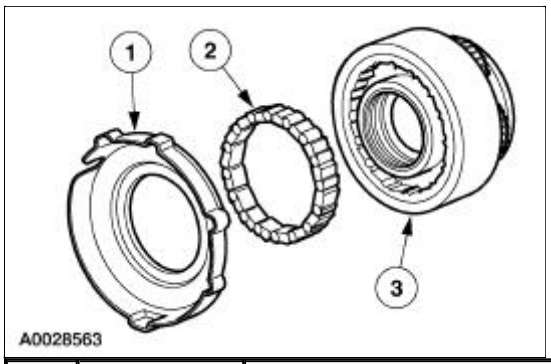


Item	Part Number	Description
1	7D044	Reverse clutch drum assembly

2	7B442	Reverse clutch plate external splined (steel)
3	7B066	Reverse clutch pressure plate (rear)
4	7D483	Reverse clutch pressure plate retaining ring (select fit)
5	7F207	Forward clutch cylinder and input shaft assembly
6	7A019	Reverse clutch sun gear assembly
7	7B164	Reverse clutch plate internal splined (friction)

The reverse clutch couples the input shaft to the reverse sun gear, applied in reverse range only.

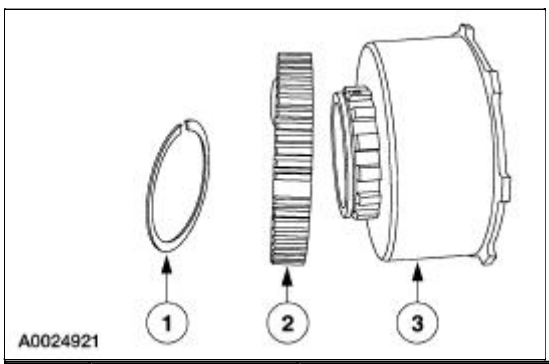
One-Way Clutch—Planetary (Low)



Item	Part Number	Description
1	7A130	Planetary gear support assembly
2	7A089	Planetary one-way clutch cage and spring roller assembly
3	7A398	Planetary assembly

The planetary (low) one-way clutch is a roller clutch that holds the planetary gearset in first gear, (D) and D ranges. During automatic coasting downshifts into first gear ((D) and D ranges), the planetary one-way clutch freewheels so there is no engine braking.

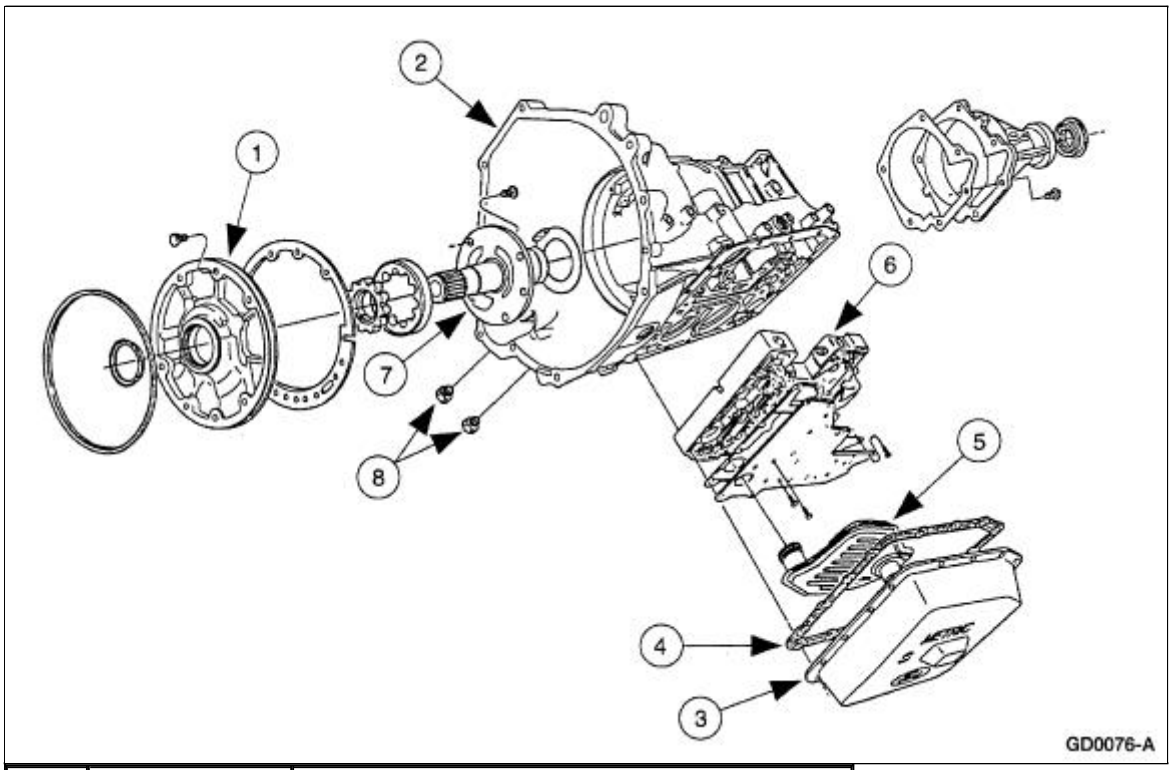
One-Way Clutch—Intermediate



Item	Part Number	Description
1	391267-S	Retaining ring
2	7A089	Intermediate one-way clutch assembly
3	7D044	Reverse clutch drum assembly

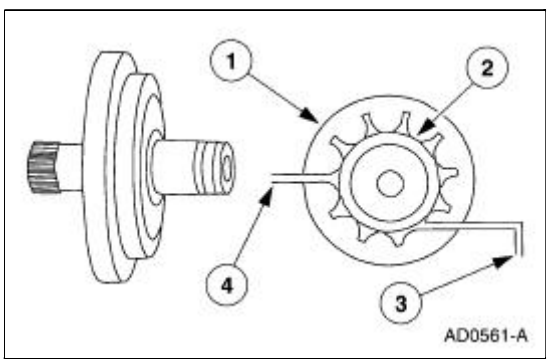
The intermediate one-way clutch works with the intermediate friction clutch to hold the reverse clutch drum and reverse sun gear stationary in second gear during acceleration. The intermediate one-way clutch freewheels in third gear and during coasting in second gear, (D) and D ranges.

Hydraulic System



Item	Part Number	Description
1	7A106	Front pump body assembly
2	7005	Case assembly
3	7A194	Transmission pan
4	7A191	Transmission pan gasket
5	7A098	Fluid filter and seal assembly
6	7A100	Main control assembly
7	7A108	Front pump support assembly
8	7D273	Fluid tube connector assembly (2 req'd)

Fluid Pump



Item	Part Number	Description

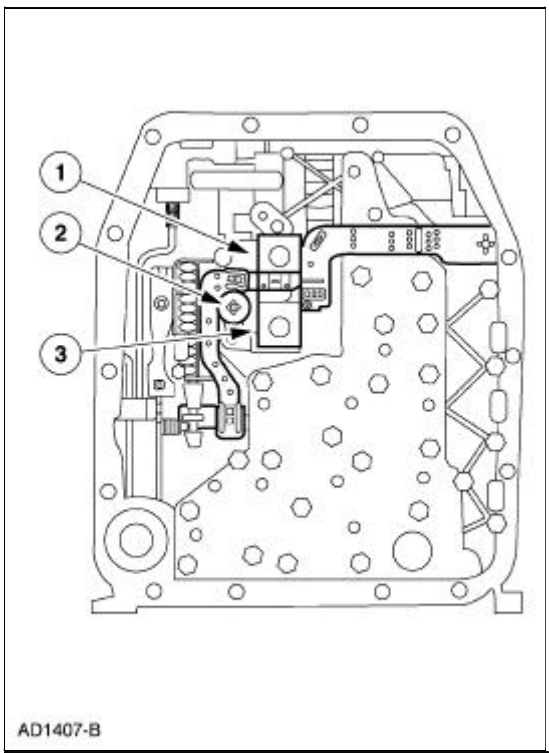
1	—	Outer rotor (part of 7A103)
2	—	Inner rotor (part of 7A103)
3	—	Outlet
4	—	Inlet

The transmission uses a gerotor-type design front pump support and gear. The pump provides the volume of fluid needed to charge the torque converter, main control assembly, cooling system and lube system. Pump pressure is regulated by the main regulator valve. The pump has an internal boost circuit which is more efficient at lower engine speeds.

Filter

All fluid drawn from the transmission pan by the pump passes through the filter. The filter and its accompanying seal are part of the fluid path from the sump (pan) to the fluid pump.

Main Control

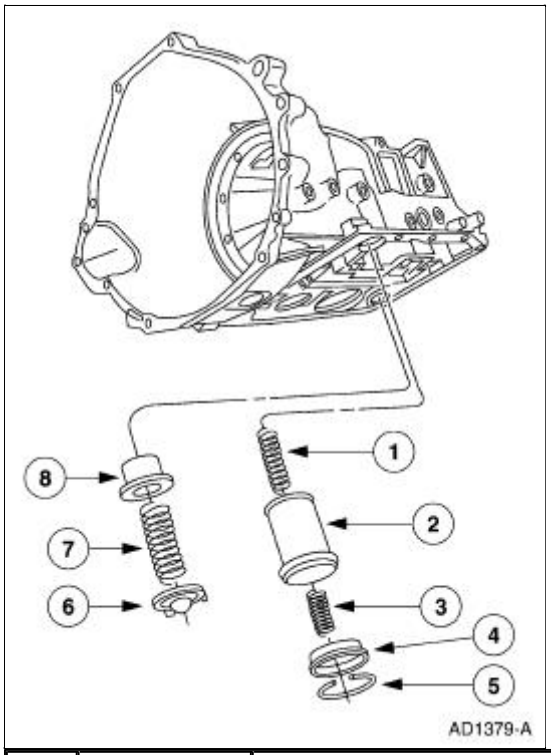


Item	Part Number	Description
1	—	Shift solenoid A (part of 7G484)
2	7G136	Torque converter clutch solenoid
3	—	Shift solenoid B (part of 7G484)

The main control valve body houses three electronic solenoids:

- two shift solenoids
- one torque converter clutch solenoid (TCC solenoid)

Accumulators



Item	Part Number	Description
1	7F284	Spring — 1-2 shift accumulator (model dependent)
2	7F251	Piston — 1-2 shift accumulator
3	7F284	Spring — 1-2 shift accumulator (model dependent)
4	7H300	Cover and seal assembly — 1-2 accumulator
5	7384	Ring — 2-1/16 retaining type HU internal
6	7B264	Retainer — 2-3 shift accumulator piston
7	7F285	Spring — 2-3 shift accumulator piston
8	7H292	Piston — 2-3 shift accumulator

The transmission uses two accumulators:

- 1-2 Accumulator — The 1-2 accumulator is used to soften the 1-2 shift by absorbing some of the pressure directed to the intermediate clutch. Constant line pressure is applied to the middle section of the 1-2 accumulator piston, opposing the intermediate clutch pressure, until the pressure is high enough to overcome line pressure. The top of the piston is exhausted to the sump.
- 2-3 Accumulator — The 2-3 accumulator is used to soften the 2-3 shift by absorbing some of the direct clutch pressure. Forward clutch pressure is applied to the top side of the 2-3 accumulator piston, holding the piston down until clutch pressure is high enough to overcome it. The middle section of the piston is exhausted to the sump.

Transmission Electronic Control System

The powertrain control module (PCM) and its input/output network control the following transmission operations:

- Shift timing
- Line pressure (shift feel)
- Torque converter clutch

The transmission control is separate from the engine control strategy in the PCM, although some of the input signals are shared. When determining the best operating strategy for transmission operation, the PCM uses input information from certain engine-related and driver-demand related sensors and switches.

In addition, the PCM receives input signals from certain transmission-related sensors and switches. The PCM also uses these signals when determining transmission operating strategy.

Using all of these input signals, the PCM can determine when the time and conditions are right for a shift, or when to apply or release the torque converter clutch (TCC). It will also determine the best line pressure needed to optimize shift feel. To accomplish this, the PCM uses hydraulic solenoids to control transmission operation.

The following provides a brief description of each of the sensors and actuators used to control transmission operation.

Powertrain Control Module (PCM)

The operation of the transmission is controlled by the powertrain control module (PCM). Many input sensors provide information to the PCM. The PCM then controls actuators which determine transmission operation.

Air Conditioning (A/C) Clutch

An electromagnetic clutch is energized when the clutch cycling pressure switch closes. The switch is located on the suction accumulator/drier. The closing of the switch completes the circuit to the clutch and draws it into engagement with the compressor driveshaft. When the A/C clutch is engaged, electronic pressure control (EPC) is adjusted by the PCM to compensate for additional load on the engine.

Brake Pedal Position (BPP) Switch

The brake pedal position (BPP) switch tells the PCM when the brakes are applied. The torque converter clutch disengages when the brakes are applied. The BPP switch closes when the brakes are applied and opens when they are released.

Engine Coolant Temperature (ECT) Sensor

The engine coolant temperature (ECT) sensor detects temperature of engine coolant and supplies the information to the powertrain control module. The ECT sensor is used to control torque converter clutch (TCC) operation. The ECT is installed in the heater outlet fitting or cooling passage on the engine. For engine control applications, the ECT signal is used to modify ignition timing, EGR flow and air-to-fuel ratio as a function of engine coolant temperature.

Ignition Coil — Coil On Plug

The engine uses eight separate coil per plug units. Each coil per plug unit is controlled by the powertrain control module (PCM).

Each coil per plug unit is mounted directly above each spark plug and activates its own spark plug in the correct sequence as controlled by the PCM.

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for additional information on the ignition system.

Intake Air Temperature (IAT) Sensor

The intake air temperature (IAT) sensor provides the sequential fuel injection (SFI) system mixture temperature information. The IAT sensor is used both as a density corrector for air flow calculation and to proportion cold enrichment fuel flow. The IAT sensor is installed in the air cleaner inlet tube. The IAT sensor is also used in determining EPC pressures.

Mass Air Flow (MAF) Sensor

The mass air flow (MAF) sensor measures the mass of air flowing into the engine. The MAF sensor output signal is used by the powertrain control module to calculate injector pulse width. For transmission strategies, the mass air flow sensor is used to regulate EPC, shift and torque converter clutch scheduling.

Transmission Control Switch (TCS) and Transmission Control Indicator Lamp (TCIL)

The transmission control switch (TCS) is a momentary contact switch. When the switch is pressed, a signal is sent to the PCM to allow automatic shifts from first through fourth gears or first through third gears only. The PCM energizes the transmission control indicator lamp (TCIL) when the switch is off. The TCIL indicates overdrive cancel mode activated (lamp on). When the TCIL is flashing, it indicates electronic pressure control (EPC) circuit shorted or a monitored sensor failure.

Throttle Position (TP) Sensor

The throttle position (TP) sensor is a potentiometer mounted on the throttle body. The TP sensor detects the position of the throttle plate and sends this information to the PCM. The TP sensor is used for shift scheduling, electronic pressure control (EPC) and TCC control.

Digital Transmission Range (TR) Sensor

The digital transmission range (TR) sensor is located on the outside of the transmission at the manual lever. The digital sensor completes the start circuit in PARK and NEUTRAL, and the back-up lamp circuit in REVERSE. The digital sensor also opens/closes a set of four switches that are monitored by the PCM to determine the position of the manual lever (P, R, N, D, 2, 1).

Output Shaft Speed (OSS) Sensor

The output shaft speed (OSS) sensor is a magnetic pickup, located at the output shaft ring gear, that sends a signal to the powertrain control module (PCM) to indicate transmission output shaft speed. The OSS sensor is used for torque converter clutch (TCC) control, shift scheduling and to determine electronic pressure control (EPC).

Electronic Pressure Control (EPC) Solenoid

The EPC solenoid regulates transmission pressure. EPC valve pressure is used to control line pressure.

Torque Converter Clutch (TCC) Solenoid

The TCC solenoid is used to control the apply and release of the TCC.

Shift Solenoid — SSA, SSB

Two on/off shift solenoids provide gear selection of first through fourth gears by controlling the pressure to the three shift valves. One unit containing the two shift solenoids is located in the main control valve body. The shift solenoids are two-way, normally open style.

Solenoid Operation Chart

		Solenoids		
Selector Lever Position	**PCM Commanded Gear**	**SSA**	**SSB**	**TCC**
P/R/N	1	ON	OFF	HD
(D)	1	ON	OFF	HD
(D)	2	OFF	OFF	EC
(D)	3	OFF	ON	EC
(D)	4	ON	ON	EC
w/OD OFF				
1	1	ON	OFF	HD
2	2	OFF	OFF	EC
3	3	OFF	ON	EC
Manual 2	2	OFF	OFF	EC
Manual 1	1	ON	OFF	HD
1 [a]	2	OFF	OFF	EC

[a] When a manual pull-in occurs above a calibrated speed, the transmission will not downshift from the higher gear until the vehicle speed drops below this calibrated speed.

EC = Electronically Controlled

HD = Hydraulically Disabled

Transmission Fluid Temperature (TFT) Sensor

The transmission fluid temperature (TFT) sensor is located on the lead frame assembly near the shift solenoids on the main control valve body. It is a temperature-sensitive device called a thermistor. It sends a voltage signal to the PCM. The voltage signal varies with transmission fluid temperature. The PCM uses this signal to determine whether a cold start shift schedule is necessary. The shift schedule is compensated when the transmission fluid temperature is cold. The PCM also inhibits (TCC) operation at low transmission fluid temperatures and corrects electronic pressure control.

Vehicle Speed (VSS) Sensor

The source of vehicle speed (VSS) is model dependent. Possible sources of vehicle speed input are anti-lock brake sensor (ABS), a gear-driven vehicle speed sensor (VSS), or an output shaft speed sensor (OSS). The VSS signal is either an A/C signal whose frequency changes with speed, or an SCP data message depending on the source. Some applications will have both. The vehicle speed signal is an input to various vehicle subsystems such as the powertrain control module (PCM), instrument cluster (speedometer and odometer), speed control system, etc. The vehicle speed source must be operational to enter output state control (OSC) mode for diagnostics.

Regardless of the type of vehicle speed system, the PCM always uses the OSS for transmission and

engine control.

Diagnostic Strategy

Troubleshooting an electronically controlled automatic transmission is simplified by using the proven method of diagnosis. One of the most important things to remember is that there is a definite procedure to follow.

NOTE: Do not take any short cuts or assume that critical checks or adjustments have already been made.

Follow the procedures as written to avoid missing critical components or steps.

To properly diagnose a concern have the following publications available:

- Transmission Reference Manual.
- Powertrain Control/Emissions Diagnosis (PC/ED) manual.
- TSBs and OASIS Messages.
- Wiring Diagram.

These publications provide the information required when diagnosing transmission concerns.

Use the Diagnostic Flow Chart as a guide and follow the steps as indicated.

Preliminary Inspection

- Know and understand the customer's concern.
- Verify the concern by operating the vehicle.
- Check the fluid levels and condition.
- Check for non-factory add-on items.
- Check shift linkages for proper adjustment.
- Check TSBs and OASIS messages regarding the concern.

Diagnostics

- Carry out on-board diagnostic procedures key on engine off (KOEO) and key on engine running (KOER).
- Record all diagnostic trouble codes (DTCs).
- Repair all non-transmission codes first.
- Repair all transmission codes second.
- Erase all continuous codes and attempt to repeat them.
- Repair all continuous codes.
- If only pass codes are obtained, refer to Diagnosis By Symptom for further information and diagnosis.

Follow the diagnostic sequence to diagnose and repair the concern the first time.

Diagnostic Flow Chart

Diagnostic Flow Chart		
• Know and understand the customer concerns • Check the fluid level and condition • Verify the concern by operating the vehicle • Check for non-factory-installed items and verify correct installation • Check the shift linkage adjustments • Check TSBs and OASIS messages for vehicle concerns • Carry out quick test both KOER and KOEO • Record all codes 1) Did you record any diagnostic trouble codes?	Yes	· REPAIR all hard diagnostic trouble codes. FOLLOW the pinpoint tests. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual first, then this Workshop Manual.
	No	· REFER to Diagnosis By Symptom in this section, then GO to Step 5.
2) Are any continuous test memory codes present?	Yes	· CLEAR codes and CARRY OUT drive cycle test.
	No	· GO to Step 4.
3) Did the continuous test memory codes reappear?	Yes	· REPAIR all continuous test memory codes. FOLLOW the pinpoint tests. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual then the transmission reference manual, then this workshop manual, then GO to Step 4.
	No	· GO to Step 4.
4) Is the concern repaired?	Yes	· CARRY OUT the final quick test to verify that no diagnostic trouble codes are present. CLEAR memory codes.
	No	· REFER to Diagnosis By Symptom in this section.
5) Are there any electrical concerns?	Yes	· INSTALL the scan tool and CARRY OUT the output state control test, then GO to Step 6.
	No	· REFER to the hydraulic and mechanical routine to diagnose and REPAIR the concern, then GO to Step 7.
6) Was the transmission concern corrected when the scan tool was installed?	Yes	· REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual, intermittent fault diagnosis section and use the scan tool to diagnose cause of concern in the processor, vehicle harness or external inputs (sensors or switches).

	No	・REFER to the hydraulic and mechanical routine to diagnose the concern, then GO to Step 7.
7) Is the concern repaired?	Yes	・CARRY OUT the final quick test to verify that no diagnostic trouble codes are present. CLEAR memory codes.
	No	・Get assistance from technical hotline.

Preliminary Inspection

The following items must be checked prior to beginning the diagnostic procedures:

Know and Understand the Concern

In order to correctly diagnose a concern, first understand the customer complaint or condition. Customer contact may be required in order to begin to verify the concern. Understand the conditions, including when the concern occurs. For example:

- Hot or cold vehicle temperature
- Hot or cold ambient temperature
- Vehicle driving conditions
- Vehicle loaded/unloaded

After understanding when and how the concern occurs, proceed to Verification of Condition.

Verification of Condition

This section provides information that must be used in both determining the actual cause of customer concerns and carrying out the appropriate procedures.

The following procedures must be used when verifying customer concerns for the transmission.

Determine Customer Concern

NOTE: Some transmission conditions can cause engine concerns. An electronic pressure control short circuit can cause engine misfiring. The torque converter clutch not disengaging will stall the engine.

Determine customer concerns relative to vehicle use and dependent driving conditions, paying attention to the following items:

- Hot or cold vehicle operating temperature
- Hot or cold ambient temperatures
- Type of terrain
- Vehicle loaded/unloaded
- City/highway driving
- Upshifting
- Downshift
- Coasting
- Engagement
- Noise/vibration — check for dependencies, either rpm dependent, vehicle speed dependent, shift dependent, gear dependent, range dependent, or temperature dependent.

Check Fluid Level and Condition

Fluid Level Check

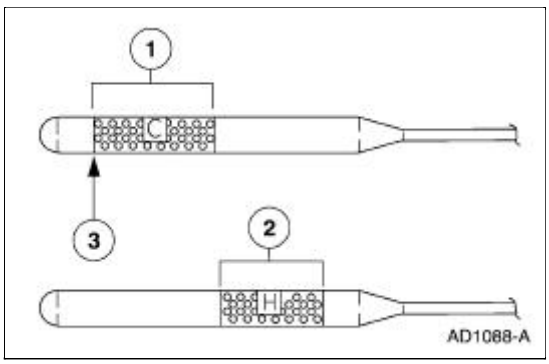
CAUTION: The vehicle should not be driven if the fluid level indicator shows the fluid below the DO NOT DRIVE mark or internal failure could result.

NOTE: If the vehicle has been operated for an extended period, at high highway speeds, in city traffic, during hot weather, or while pulling a trailer, the fluid needs to cool down to obtain an accurate reading.

NOTE: The fluid level reading on the indicator will differ from operating and ambient temperatures. The correct reading should be within the normal operating temperature range.

Under normal circumstances the fluid level should be checked during normal maintenance. If the transmission starts to slip, shifts slowly, shows signs of fluid leaking, the fluid level should be checked.

1. With the transmission in P (PARK), the engine at idle, foot pressed on the brake, move the range selector lever through each gear and allow engagement of each gear. Place the transmission range selector lever in the P position.
2. Wipe the fluid level indicator cap and remove the indicator.
3. Wipe the indicator with a clean cloth.
4. Install the indicator back in the filler tube until it is fully seated, then remove the indicator. The fluid level should be within the normal operating temperature range.



Item	Description
1	Fluid level at room temperature 10°-35°C (50°-95°F)
2	Fluid level at operating temperature 66°-77°C (150°-170°F)
3	Do not drive mark

High Fluid Level

A fluid level that is too high may cause the fluid to become aerated due to the churning action of the rotating internal parts. This will cause erratic control pressure, foaming, loss of fluid from the vent tube, and possible transmission failure. If an overfill reading is indicated, drain and refill the transmission.

Low Fluid Level

A low fluid level could result in poor transmission engagement, slipping, or failure. This could also indicate a leak in one of the transmission seals or gaskets.

Adding Fluid

CAUTION: The use of any other type of transmission fluid than specified could result in transmission failure.

If fluid needs to be added, add fluid in 0.25L (1/2 pint) increments through the filler tube. Do not overfill the fluid. For fluid type, refer to the specification chart.

Fluid Condition Check

1. Check the fluid level.
2. Observe the color and the odor. The color under normal circumstances should be dark reddish, not brown or black or have a burnt odor.
3. Hold the fluid level indicator over a white facial tissue and allow the fluid to drip onto the facial tissue and examine the stain.
4. If evidence of solid material is found, the transmission fluid pan should be removed for further inspection.
5. If the stain is a foamy pink color this may indicate coolant in the transmission. The engine cooling system should also be inspected at this time.
6. If fluid contamination or transmission failure is confirmed by the sediment in the bottom of the fluid pan, the transmission must be disassembled and completely cleaned. This includes the torque converter and cooler tubes. The oil-to-air cooler will need to be installed.
7. Carry out diagnostic checks and adjustments. Refer to Diagnosis By Symptom in this section.

Road Testing Vehicle

NOTE: Always drive the vehicle in a safe manner according to the driving conditions and obey all traffic laws.

The shift point road test and torque converter operation tests provide diagnostic information on transmission shift controls and torque converter operation.

Shift Point Road Test

This test verifies that the shift control system is operating correctly.

1. Bring engine and transmission up to normal operating temperature.

2. Operate vehicle with transmission range selector lever in (D) position.

3. **NOTE:** Shift speed ranges are approximate for all applications. For specific applications (engine, axle ratio and application) refer to the Automatic Transmission Specification Issue, available from Ford Customer Service Division.

   Apply minimum throttle and observe speeds at which upshift occurs and torque converter engages; refer to the 4R70W Shift Speeds chart in this section.

4. With the transmission in Overdrive (fourth gear), press the transmission control switch. The transmission should downshift to third gear. Release the accelerator pedal; engine braking should occur.

5. Press accelerator pedal to floor, wide open throttle (WOT). Transmission should shift from third to second gear, or third to first, depending on vehicle speed. Torque converter clutch should disengage and then reapply.

6. With the transmission in (D) position and speed above 80 km/h (50 mph) and less than half throttle, move the transmission range selector lever from (D) position to manual 2 position and remove pressure from the accelerator pedal. Transmission should immediately downshift into second gear. With vehicle remaining in manual 2 position, move the transmission range selector lever into manual 1 position, and release accelerator pedal. Transmission should downshift into first gear at speeds approximately below 45-56 km/h (28-35 mph).

7. If transmission fails to upshift/downshift or torque converter clutch does not apply and release, refer to Diagnosis By Symptom in this section.

Shift Speeds 4.6L 4V MACH 1 (3.55:1 Axle Ratio)

Throttle Position	Shift	MPH	Km/H
Light throttle	1-2	10-14	16-23
TP voltage	2-3	18-22	29-35
1.25 volts	3-4	34-37	55-60
Closed throttle	4-3	22-25	35-40
	3-2	12-16	19-26
	2-1	11-7	18-11
Wide open throttle	1-2	36-44	58-71
	2-3	75-83	121-134
	3-2	70	113
	2-1	33	53

Shift Speeds 4.6L 2V HO (3:27:1 Axle

Ratio)

Throttle Position	Shift	MPH	Km/H
Light throttle	1-2	9-12	14-19
TP voltage	2-3	14-18	23-29
1.25 volts	3-4	36-38	58-61
Closed throttle	4-3	26-22	42-35
	3-2	15-11	24-18
	2-1	12-8	19-13
Wide open throttle	1-2	29-44	47-71
	2-3	74-80	119-129
	3-2	73	117
	2-1	32	51

Shift Speeds 3.8L (3:27:1 Axle Ratio)

Throttle Position	Shift	MPH	Km/H
Light throttle	1-2	6-10	10-16
TP voltage	2-3	18-22	29-35
1.25 volts	3-4	28–30	45–48
Closed throttle	4-3	24-22	39-35
	3-2	14-12	22-19
	2-1	6-8	10-13
Wide open throttle	1-2	36-40	58-64
	2-3	74-70	119-112
	3-2	67	108
	2-1	28	45

Shift Speeds 3.8L (3:08:1 Axle Ratio)

Throttle Position	Shift	MPH	Km/H
Light throttle	1-2	6-10	10-16
TP voltage	2-3	16-20	26-32
1.25 volts	3-4	38-42	61-68
Closed throttle	4-3	34-28	55-45
	3-2	16-13	26-21
	2-1	9-7	14-11
Wide open throttle	1-2	38-45	61-72
	2-3	72-76	116-122
	3-2	71	114
	2-1	31	50

Torque Converter Diagnosis

Prior to the installation of a new or remanufactured torque converter, all diagnostic procedures must be followed. This is to prevent the unnecessary installation of torque converters. Only after a complete diagnostic evaluation can the decision be made to install a new or remanufactured torque converter.

Begin with the normal diagnostic procedures as follows:

1. Preliminary inspection.
2. Know and understand the customer's concern.
3. Verify the condition — carry out the torque converter operation test.
4. Carry out diagnostic procedures.

- Carry out on-board diagnostics; refer to Diagnostics.
  - Repair all non-transmission related DTCs first.
  - Repair all transmission DTCs.
  - Rerun on-board diagnostic to verify repair.
- Carry out Line Pressure Test. For additional information, refer to Special Testing Procedures in this section.
- Carry out Stall Speed Test. For additional information, refer to Special Testing Procedures in this section.
- Carry out Diagnostic Routines. For additional information, refer to Diagnosis By Symptom in this section.
  - Use the Diagnosis by Symptom Index to locate the appropriate routine that best describes the symptom(s). The routine will list all possible components that may cause or contribute to the symptom. Check each component listed; diagnose and repair as required before changing the torque converter.

Torque Converter Operation Test

This test verifies that the torque converter clutch control system and the torque converter are operating correctly.

5. Carry out Quick Test with scan tool. For additional information, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Check for DTCs.
6. Connect a tachometer to the engine.
7. Bring the engine to normal operating temperature by driving the vehicle at highway speeds for approximately 15 minutes in (D) position.
8. After normal operating temperature is reached, maintain a constant vehicle speed of about 80 km/h (50 mph) and tap brake pedal with the left foot.
9. Engine rpm should increase when brake pedal is tapped, and decrease about five seconds after pedal is released. If this does not occur, see torque converter operation concerns. For additional information, refer to Diagnosis By Symptom in this section.

10. If the vehicle stalls in (D) or manual 2 at idle with vehicle at a stop, move the transmission range selector lever to manual 1 position. If the vehicle stalls, see torque converter operation concerns. For additional information, refer to Diagnosis By Symptom in this section. If the vehicle does not stall in (D), refer to Diagnosis By Symptom in this section.

11. If the vehicle exhibits a vibration during the road test, complete the Road Test Evaluation Form. This form will aid the technician in determining the source of the vibration.

NOTE: The following is a list of common vehicle concerns that have been misdiagnosed as torque converter clutch shudder. For diagnosis of the following items refer to the appropriate sections of the workshop manual and the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

- spark plugs - check for cracks, high resistance or broken insulators
- plug wires
- fuel injector - filter may be plugged
- fuel contamination - poor engine performance
- EGR valve - valve may let in too much exhaust gas and cause engine to run lean
- vacuum leak - engine will not get correct air/fuel mixture
- MAP/MAF sensor - incorrect air/fuel mixture
- HO2S sensor - too rich/lean air/fuel mixture
- fuel pressure - may be too low
- engine mounts - loose/damaged mounts can cause vibration concerns
- axle joints - check for vibration

Torque Converter Road Evaluation Form		
1) Does the Torque Converter Engage/Disengage?	Yes	· GO to Step 2.
	No	· REFER to Diagnosis By Symptom — Torque Converter No Apply Routine 240/340 and Always Applied Routine 241/341 in this section for further diagnosis information. Repair as required, verify converter operation and then continue.
2) Does vibration occur during 3-4 or 4-3 shift at: light, medium, or heavy throttle?	Light	· May be torque converter clutch shudder. GO to Step 3.
	Medium	· May be torque converter clutch shudder. GO to Step 3.
	Heavy	· Not torque converter clutch shudder — converter does not engage due to PCM strategy. REFER to Section 100-04 and Diagnosis By Symptom — Noise/Vibration Routine 254/354 in this section for further diagnosis.
3) Is the problem vehicle speed dependent	Yes	· Not torque converter clutch shudder

(operating at steady speed, i.e. 64 km/h (40 mph) regardless of transmission range. Verify by manually selecting 2nd, OD cancel, and OD.		— REFER to Section 100-04 and Diagnosis By Symptom — Noise/Vibration Routine 254/354 in this section for further diagnosis.
	No	· GO to Step 4.
4) Is the problem engine-rpm dependent? (Occurs at the same engine rpm independent of transmission gear. Verify by holding same rpm in each transmission gear.)	Yes	· Not torque converter clutch shudder — REFER to Section 100-04 and Diagnosis By Symptom — Noise/Vibration Routine 254/354 in this section for further diagnosis.
	No	· GO to Step 5.
5) Does the problem occur in coast, steady speed, or reverse range?	Yes	· Not torque converter clutch shudder — REFER to Section 100-04 and Diagnosis By Symptom — Noise/Vibration Routine 254/354 in this section for further diagnosis.
	No	· GO to Step 6.
6) Does vibration occur during extended light brake application?	Yes	· Not torque converter clutch shudder — REFER to Section 100-04 , Section 206-00 and Diagnosis By Symptom — Noise/Vibration Routine 254/354 in this section for further diagnosis.
7) If one of the driving modes in Step 2 identifies a vibration which was not present in Steps 3-6, then there is a strong possibility that the vibration is caused by the torque converter clutch function. Carry out the repair procedures as found under Disassembly/Assembly.	No	· GO to Step 7.

Visual Inspection

This inspection will identify modifications or additions to the vehicle operating system that may affect diagnosis. Inspect the vehicle for non-Ford factory add-on devices such as:

- electronic add-on items:
  - air conditioning
  - generator (alternator)
  - engine turbo
  - cellular telephone
  - cruise control
  - CB radio
  - linear booster
  - backup alarm signal
  - computer
- Vehicle modification:

These items, if not installed correctly, will affect the powertrain control module (PCM), or transmission function. Pay particular attention to add-on wiring splices in the PCM harness or transmission wiring harness, abnormal tire size, or axle ratio changes.

- Leaks; refer to Leak Inspection.
- Correct linkage adjustments; refer to Section 307-05 .

Shift Linkage Check

Check for a misadjustment in shift linkage by matching the detents in the transmission range selector lever with those of the manual lever in the transmission. If they match, the misadjustment is in the indicator. Do not adjust the shift linkage.

Hydraulic leakage at the manual control valve can cause delay in engagements and/or slipping while operating if the linkage is not correctly adjusted. Refer to Section 307-05 for shift linkage adjustment.

Check TSBs and OASIS

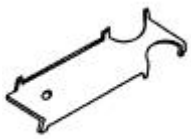
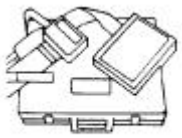
Refer to all technical service bulletins (TSB) and OASIS messages which pertain to the transmission concern and follow the procedure as described.

Carry Out On-Board Diagnostics (KOEO, KOER)

After a road test, with the vehicle warm and before disconnecting any connectors, carry out the Quick Test using the scan tool. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Diagnostics

Special Tool(s)

ST1565-A	Transmission Fluid Pressure Gauge 307-004 (T57L-77820-A)
ST1392-A	Air Test Plate, Transmission 307-246 (T92P-7006-A)
 ST1633-A	Alignment Gauge, TR Sensor 307-351 (T97L-70010-A)
 ST1391-A	Breakout Box, EEC-V Control System 418-049 (T94L-50-EEC-V) or equivalent
ST1632-A	MLP-TR Cable 418-F107 (007-00111) or equivalent
ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052 or equivalent scan tool
ST1389-A	Transmission Tester 307-F016 (007-00130) or equivalent
	Trans Tester TR/MLP Overlay

	and Manual 007-00131 or equivalent
 ST1137-A	73 III Automotive Meter 105-R0057 or equivalent
 ST1300-A	UV Leak Detector Kit 164-R0756 or equivalent

Diagnosing an electronically controlled automatic transmission is simplified by using the following procedures. One of the most important things to remember is that there is a definite procedure to follow. DO NOT TAKE SHORT CUTS OR ASSUME THAT CRITICAL CHECKS OR ADJUSTMENTS HAVE ALREADY BEEN MADE. Follow the procedures as written to avoid missing critical components or steps. By following the diagnostic sequence, the technician will be able to diagnose and repair the concern the first time.

On-Board Diagnostics With Diagnostic Tool

NOTE: For detailed instruction and other diagnostic methods using the scan tool, refer to the scan tool tester manual and the Powertrain Control/Emissions Diagnosis (PC/ED) manual. These quick tests should be used to diagnose the powertrain control module (PCM) and should be carried out in order.

- **Quick Test 1.0 - Visual Inspection**
- **Quick Test 2.0 - Set Up**
- **Quick Test 3.0 - Key On, Engine Off (KOEO)**
- **Quick Test 4.0 - Continuous Memory**
- **Quick Test 5.0 - Key On, Engine Running (KOER)**
  - Special Test Mode
  - Wiggle Test
  - Output Test Mode
  - PCM Reset Mode
  - Clearing DTCs
  - OBD II Drive Cycle
- **Other Scan Tool Features**

For further information on other diagnostic testing features using the scan tool, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Other diagnostic methods include the following:

- Parameter Identification (PID) Access Mode
- Freeze Frame Data Access Mode

- Oxygen Sensor Monitor Mode

Output State Control (OSC) Mode

Output State Control (OSC) allows the technician to take control of certain parameters to function the transmission. For example, OSC allows the technician to shift the transmission only when he/she commands a gear change. If the technician commands 1st gear in OSC, the transmission will remain in 1st gear until the technician commands the next gear. Another example, the technician can command a shift solenoid to turn on or off when carrying out an electrical circuit check. OSC has two modes of operation for transmission, the BENCH MODE and the DRIVE MODE. Each mode/parameter has a unique set of vehicle operating requirements that the technician is required to meet before being allowed to operate OSC.

NOTE: To operate OSC the digital transmission range (TR) sensor must be operational. No Diagnostic Trouble Codes (DTCs) related to the digital TR sensor can be present.

To operate OSC the vehicle speed source must be operational. No diagnostic codes (DTCs) related to this source can be present. The vehicle speed source can vary depending on vehicle configuration. Technicians should verify which input source is applicable for their vehicle application. The following are potential vehicle speed sources:

- anti-lock braking system (ABS)
- output shaft speed (OSS) sensor
- vehicle speed sensor

- The vehicle requirements MUST BE MET when SENDING the OSC value. Refer to individual test modes for vehicle requirements.
- If the vehicle requirements are NOT MET when SENDING the OSC value, an ERROR MESSAGE will appear. When the ERROR MESSAGE is received, OSC is aborted and must be restarted.
- If AFTER SENDING an OSC value, and the vehicle requirements are no longer met, the PCM will cancel the OSC value and NO ERROR message will appear. Once the vehicle requirements are met again, the PCM will automatically SEND the previous OSC value without any additional actions required by the service technician.
- The OSC value XXX may be sent anytime to cancel OSC.

Output State Control (OSC) Procedures

- Carry out visual inspection and vehicle preparation as required.
- Select "Vehicle and Engine Selection" menu.
- Select appropriate vehicle and engine.
- Select "Diagnostic Data Link."
- Select "Powertrain Control Module."
- Select "Output Test Mode."
- Select "KOEO On-Demand Self Test and KOER On-Demand Self Tests."
- Carry out test and record DTCs.
- Repair all NON-Transmission DTCs.
- Repair all digital TR Sensor DTCs.

- Repair all vehicle speed DTCs.
- Make sure that the vehicle speed sensor and digital TR sensors are functional.
- Select "Active Command Modes."
- Select "Trans - Bench Mode or Trans - Drive Mode."

OSC — Transmission Bench Modes

The following Transmission Bench Modes may be used or required during diagnostics.

SSA, SSB and TCC in BENCH MODE

The BENCH MODE allows the technician to carry out electrical circuit checks on the following components:

- SSA - activates SSA OFF or ON.
- SSB - activates SSB OFF or ON.
- Transmission converter clutch (TCC) - activates TCC OFF or ON.

OSC "SSA, SSB, TCC" BENCH MODE operates ONLY when:

- the digital TR sensor is operational and no digital TR sensor DTCs are present.
- the vehicle speed input is operational and no VSS sensor DTCs are present.
- the transmission range selector lever is in P.
- the key is ON.
- the engine is OFF.

OSC Command Values

- OFF - turns solenoid OFF.
- ON - turns solenoid ON.
- XXX - cancels OSC value sent.
- SEND - sends the values to PCM.

BENCH MODE Procedure for SSA, SSB and TCC

Follow operating instructions from the scan tool menu screen:

- Select "Output State Control."
- Select "Trans - Bench Mode."
- Select "PIDs" to be monitored.
- Monitor all selected PIDs during test.
- Select "Parameters - SSA, SSB or TCC."
- Select "ON" to turn solenoid ON.
- Press "SEND" to send command ON.
- Select "OFF" to turn solenoid OFF.
- Press "SEND" to send command OFF.

- Select "XXX" to cancel at any time.
- Press "SEND."

EPC in BENCH MODE

The BENCH MODE is also used to test the functionality of the transmission's electronic pressure control. During BENCH MODE, the electronic pressure control (EPC) solenoid can ramp up/down in increments of 103 kPa (15 psi) from zero to 620 kPa (90 psi) and 620 kPa (90 psi) to zero psi.

The OSC functions for the parameter EPC allows the technician to choose the following options:

- EPC - activates EPC to selected values.
- 00 - sets EPC pressure to 00 kPa (00 psi).
- 15 - sets EPC pressure to 103 kPa (15 psi).
- 30 - sets EPC pressure to 206 kPa (30 psi).
- 45 - sets EPC pressure to 310 kPa (45 psi).
- 60 - sets EPC pressure to 411 kPa (60 psi).
- 75 - sets EPC pressure to 517 kPa (75 psi).
- 90 - sets EPC pressure to 620 kPa (90 psi).

To carry out an EPC BENCH MODE pressure functionality test, install a pressure gauge in the EPC port. The following requirements are required to carry out this test:

- VSS and digital TR sensor operational
- No VSS and digital TR sensor DTCs
- Transmission range selector lever in P
- Key ON
- Engine ON
- Engine speed at least 1,500 rpm for accurate EPC pressure measurement

To carry out an EPC BENCH MODE solenoid circuit pinpoint test, the following requirements are required.

- VSS and digital TR sensor operational
- No VSS and digital TR sensor DTCs
- Transmission range selector lever in P
- Key ON
- Engine OFF

OSC Command Values

- 00 - sets EPC pressure to 00 kPa (00 psi).
- 15 - sets EPC pressure to 103 kPa (15 psi).
- 30 - sets EPC pressure to 206 kPa (30 psi).
- 45 - sets EPC pressure to 310 kPa (45 psi).
- 60 - sets EPC pressure to 411 kPa (60 psi).

- 75 - sets EPC pressure to 517 kPa (75 psi).
- 90 - sets EPC pressure to 620 kPa (90 psi).
- XXX - cancels OSC value sent.
- SEND - sends the values to PCM.

BENCH MODE Procedure for EPC

Follow operating instructions from the scan tool menu screen:

- Select "Output State Control."
- Select "Trans - Bench Mode."
- Select "PIDs" to be monitored.
- Monitor all selected PIDs during test.
- Select "Parameters - EPC."
- Select Value "0-620 kPa (0-90 psi)."
- Press "SEND" to send command.
- Select "XXX" to cancel at any time.
- Press "SEND."

OSC — Transmission DRIVE MODES

The DRIVE MODE allows control of three transmission parameters. Each mode/parameter has a unique set of vehicle operating requirements that the technician is required to meet before being allowed to operate OSC. The recommended procedure, when using the DRIVE MODE, is to control one parameter at a time.

The DRIVE MODE allows the technician to carry out the following functions on the transmission:

- GR_CM - allows upshifts or downshifts.
- TCC - engages or disengages the torque converter clutch.
- EPC - increases/decreases EPC pressure.

GR_CM in DRIVE MODE

This OSC function is used to test the transmission shift functions.

The OSC functions for the GR_CM parameter allows the technician to choose the following options:

- 1 - PCM selects 1st gear.
- 2 - PCM selects 2nd gear.
- 3 - PCM selects 3rd gear.
- 4 - PCM selects 4th gear.

OSC "GR_CM" Mode operates ONLY when:

- the digital TR sensor is operational and no digital TR sensor DTCs are present.
- the vehicle speed sensor is operational and no VSS sensor DTCs are present.

- the engine is ON.
- the TCC is OFF.
- the transmission range selector lever is in O/D.
- the vehicle speed is greater than 3.2 km/h (2 mph).

OSC Command Values

- 1 - PCM selects 1st gear.
- 2 - PCM selects 2nd gear.
- 3 - PCM selects 3rd gear.
- 4 - PCM selects 4th gear.
- XXX - cancels OSC value sent.
- SEND - sends the values to PCM.

DRIVE MODE Procedure for GR_CM

Follow operating instructions from the scan tool menu screen.

- Select "Output State Control."
- Select "Trans - DRIVE MODE."
- Select "PIDs" to be monitored.
- Monitor all selected PIDs during test.
- Select "Parameters - GR_CM."
- Select Value "1-4."
- Press "SEND" to send command.
- Re-Select Value "1-4."
- Press "SEND" to send command.
- Select "XXX" to cancel at any time.
- Press "SEND."

TCC in DRIVE MODE

This OSC function is used to test whether the torque converter clutch is engaging and disengaging correctly.

The OSC functions for the TCC parameter allows the technician to choose the following:

- TCC - activates TCC OFF and ON.
- ON - turns TCC solenoid ON.
- OFF - turns TCC solenoid OFF.

OSC "TCC OFF" DRIVE MODE operates ONLY when:

- the digital TR sensor is operational and no digital TR sensor DTCs are present.
- the vehicle speed sensor is operational and no VSS sensor DTCs are present.

- the engine is ON.
- the transmission range selector lever is in O/D.
- the vehicle speed is greater than 3.2 km/h (2 mph).

OSC "TCC ON" DRIVE MODE operates ONLY when:

- the digital TR sensor is operational and no digital TR sensor DTCs are present.
- the vehicle speed sensor is operational and no VSS sensor DTCs are present.
- the engine is ON.
- the transmission range selector lever is in O/D.
- the vehicle speed is greater than 3.2 km/h (2 mph).
- the transmission is in 2nd gear or higher.
- the TFT is between 15 and 135°C (60 and 275°F).
- the brake is not applied "OFF" below 32 km/h (20 mph).
- (Not an excessive load on engine (engine lugging).

OSC Command Values

- OFF - turns TCC OFF.
- ON - turns TCC ON.
- XXX - cancels OSC value sent.
- SEND - sends the values to PCM.

Drive Mode Procedures for TCC

Follow operating instructions from the scan tool menu screen.

- Select "Output State Control."
- Select "Trans - Drive Mode."
- Select "PIDs" to be monitored.
- Monitor all selected PIDs during test.
- Select "Parameters - TCC."
- Select "ON" to turn solenoid ON.
- Press "SEND" to send command ON.
- Select "OFF" to turn solenoid OFF.
- Press "SEND" to send command OFF.
- Select "XXX" to cancel at any time.
- Press "SEND."

EPC in DRIVE MODE

This OSC function is used to increase the EPC pressure while testing the transmission shift functions. This OSC function can only increase the EPC pressure greater than what the PCM normally commands. If an OSC value, such as (75) or (90) psi is sent, the upshifts and downshifts should exhibit a firmer shift. Firmer shifts would indicate that the EPC pressure control is working at higher

pressures. The best test for the EPC is to use the BENCH MODE and a hydraulic pressure gauge. Using EPC in the BENCH MODE will confirm that the EPC is working at both the higher and lower pressures.

The OSC functions for the parameter EPC allows the technician to choose the following options:

- EPC - activates EPC to selected values
  - 00 - sets EPC pressure to 00 kPa (00 psi).
  - 15 - sets EPC pressure to 103 kPa (15 psi).
  - 30 - sets EPC pressure to 206 kPa (30 psi).
  - 45 - sets EPC pressure to 310 kPa (45 psi).
  - 60 - sets EPC pressure to 411 kPa (60 psi).
  - 75 - sets EPC pressure to 517 kPa (75 psi).
  - 90 - sets EPC pressure to 620 kPa (90 psi).

OSC "EPC" DRIVE MODE operates ONLY when:

- the digital TR sensor is operational and no digital TR sensor DTCs are present.
- the vehicle speed sensor is operational and no VSS sensor DTCs are present.
- the transmission range selector lever is in O/D.
- the pressure gauge is installed.
- the key is ON.
- the engine is ON.
- the vehicle speed is greater than 3.2 km/h (2 mph).
- the OSC value for EPC must be greater than what the PCM commands (see EPC PID).

OSC Command Values

- 00 - sets EPC pressure to 00 kPa (00 psi).
- 15 - sets EPC pressure to 103 kPa (15 psi).
- 30 - sets EPC pressure to 206 kPa (30 psi).
- 45 - sets EPC pressure to 310 kPa (45 psi).
- 60 - sets EPC pressure to 411 kPa (60 psi).
- 75 - sets EPC pressure to 517 kPa (75 psi).
- 90 - sets EPC pressure to 620 kPa (90 psi).
- XXX - cancels OSC value sent.
- SEND - sends the values to PCM.

DRIVE MODE Procedure for EPC.

Follow operating instructions from the scan tool menu screen.

- Select "Output State Control."
- Select "Trans - Drive Mode."
- Select "PIDs" to be monitored.

- Monitor all selected PIDs during test.
- Select "Parameters - EPC."
- Select Value "0-620 kPa (0-90 psi)."
- Press "SEND" to send command.
- Re-Select Value "0-620 kPa (0-90 psi)."
- Press "SEND" to send command.
- Select "XXX" to cancel at any time.
- Press "SEND."

Using Output State Control and Accessing PIDs

To confirm that the OSC value was sent by the scan tool and the EEC has accepted the OSC substitution, a corresponding PID for each OSC parameter must be monitored. Additional PIDs should be monitored to help the technician adequately diagnose the transmission.

The following is a list of OSC parameters and their corresponding PID:

OSC PARAMETER CHART

OSC Parameter	PID	Additional PIDs
SSA	SSA	SS1F
SSB	SSB	SS2F
TCC	TCC	TCCF, TCCMACT (do not use PID TCCMCMD during OSC)
EPC	EPC	—
GR_CM	GEAR	TRANRAT

To confirm that the OSC substitution occurred, SEND the OSC value and monitor the corresponding PID value. If no ERROR MESSAGE was received and the value of the corresponding PID remains the same as the value sent from OSC, then the OSC substitution was successful.

Transmission Drive Cycle Test

NOTE: Always drive the vehicle in a safe manner according to driving conditions and obey all traffic laws.

NOTE: The Transmission Drive Cycle Test must be followed exactly. Malfunctions must occur four times consecutively for shift error DTC code to be set, and five times consecutively for continuous TCC code to set.

NOTE: When carrying out the Transmission Drive Cycle Test, refer to the Solenoid Application Chart for correct solenoid operation.

After carrying out the Quick Test, use the Transmission Drive Cycle Test for checking continuous codes.

1. Record and then erase Quick Test codes.
2. Warm engine to normal operating temperature.
3. Make sure transmission fluid level is correct.
4. With transmission in OVERDRIVE, moderately accelerate from stop to 80 km/h (50 mph). This allows the transmission to shift into fourth gear. Hold speed and throttle open steady for a minimum of 15 seconds.
5. With transmission in fourth gear and maintaining steady speed and throttle opening, lightly apply and release brake to operate stoplamps. Then hold speed and throttle steady for a minimum of five seconds.
6. Brake to a stop and remain stopped for a minimum of 20 seconds.
7. Repeat steps 4 through 6 at least five times.
8. Carry out Quick Test and record continuous DTCs.
    - If the DTCs are still present, refer to the Diagnostic Trouble Code Chart. Repair all non transmission DTCs first as they can directly affect the operation of the transmission. Repeat the Quick Test and the Road Test to verify the correction. Erase the DTCs, carry out the Drive Cycle Test and repeat the Quick Test after completing repair on the DTC.
    - If the continuous test passes and a concern is still present, refer to Diagnosis By Symptom in this section, OASIS messages, and TSBs for concerns.

After On-Board Diagnostic

NOTE: The vehicle wiring harness, PCM and non-transmission sensors may affect transmission operations. Repair these concerns first.

After the on-board diagnostic procedures are completed, repair all DTCs.

Begin with non-transmission related DTCs, then repair any transmission related DTCs. Use the diagnostic trouble code chart for information on condition and symptoms. This chart will be helpful in referring to the correct manual(s) and aids in diagnosing internal transmission concerns and external non-transmission inputs. The pinpoint tests are used in diagnosing transmission electrical concerns. Make sure that the vehicle wiring harness and the PCM are diagnosed as well. The Powertrain

Control/Emissions Diagnosis (PC/ED) manual will aid in diagnosing non-transmission electronic components.

Before Pinpoint Tests

NOTE: Prior to entering pinpoint tests, check the PCM wiring harness for tight connections, bent or broken pins, corrosion, loose wires, correct routing, correct seals and their condition. Check the PCM, sensors and actuators for damage. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

NOTE: If a concern still exists after electrical diagnosis has been carried out, refer to Diagnosis By Symptom in this section.

If DTCs appear while carrying out the on-board diagnostics, refer to the Diagnostic Trouble Code Charts for the appropriate repair procedure. Prior to entering pinpoint tests, refer to any TSBs and OASIS messages for transmission concerns.

Diagnostic Trouble Code Charts

Diagnostic Trouble Code Chart

Five Digit DTC	Component	Description	Condition	Symptom	Action
P0102 P0103 P1100 P1101	MAF	MAF concerns	MAF system has a malfunction which may cause a transmission concern.	High or low EPC pressure, incorrect shift schedule. Incorrect torque converter clutch engagement scheduling. Symptoms similar to a throttle position (TP) failure.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0112	IAT	IAT indicates 125°C (257°F) (grounded)	Voltage drop across IAT exceeds scale set for temperature 125°C (257°F).	Incorrect EPC pressure, either high or low, results in harsh or soft shifts.	REFER to thePowertrain Control/Emissions Diagnosis (PC/ED) manual.
P0113	IAT	IAT indicates -40°C (-40°F) (open circuit)	Voltage drop across IAT exceeds scale set for temperature -40°C (-40°F).	Incorrect EPC pressure, either high or low, results in harsh or soft shifts.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0114	IAT	IAT out of on-board diagnostic range	IAT temperature higher or lower than expected during KOEO and KOER.	Rerun on-board diagnostic at normal operating temperature.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0117	ECT	ECT indicates 125°C (257°F)	Voltage drop across ECT exceeds scale set for temperature 125°C (257°F) (grounded).	Torque converter clutch will always be off, resulting in reduced fuel economy.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0118	ECT	ECT indicates -40°C (-40°F)	Voltage drop across ECT exceeds scale set for temperature -40°C (-40°F) (open circuit).	Torque converter clutch will always be off, resulting in reduced fuel economy.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0122 P0123 P1120	TP	TP concern	PCM has detected an error that may cause a transmission concern.	Harsh engagements, firm shift feel, abnormal shift schedule, torque converter clutch does not engage, torque converter clutch cycling.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0300-	Electronic	EI systems	EI system has a	Harsh	REFER to the

P0308 P0320 P0340 P1351- P1364	Ignition (EI)	concerns	malfunction which may cause a transmission concern.	engagements and shifts, late WOT shifts, no torque converter clutch engagement.	Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0503 P0500 P1500 P1502	VSS	Insufficient VSS input	PCM detected a loss of vehicle speed signal during operation.	Possible loss of speedometer or speedometer fluctuation.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1702	Digital TR	Intermittent DTC codes P0705 or P0708	Refer to DTC codes P0705 or P0708 condition.	Refer to DTC codes P0705 or P0708 symptom.	Go To Pinpoint Test C .
P1704	Digital TR	Digital TR circuit reading in between gear position during KOEO/KOER	Digital TR sensor or shift cable incorrectly adjusted; or digital TR circuit failure.	Wrong commanded EPC pressure. Digital TR reading the wrong gear position.	Go To Pinpoint Test C .
P0705	Digital TR sensor	Digital TR circuit failure	Digital TR circuits, indicating an invalid pattern in TR_D. Condition caused by a short to ground or an open in TR4, TR3A, TR2, and or TR1 circuits. This DTC cannot be set by an incorrectly adjusted digital TR sensor.	Increase in EPC pressure (harsh shifts). Defaults to (D) or D for all gear positions. In (D) position trans stuck in D or manual 2.	Go To Pinpoint Test C .
P0707	Digital TR sensor, wiring, PCM	Digital TR sensor circuit below minimum voltage	Digital TR sensor, circuit or PCM shorted or grounded.	Increase in EPC pressure.	Go To Pinpoint Test C .
P0708	Digital TR	Digital TR sensor circuit TR3A open	Digital TR sensor circuit TR3A reading 2.6v - 5.0v (open circuit). This DTC cannot be set by an incorrectly adjusted digital TR sensor.	Increase in EPC pressure. Defaults to (D)or D for all gear ranges.	Go To Pinpoint Test C .
P1705	Digital TR sensor	Digital TR self test was not carried out in PARK or NEUTRAL	Vehicle not in PARK or NEUTRAL during on-board diagnostic.	Rerun on-board diagnostic in PARK or NEUTRAL.	Go To Pinpoint Test C .
P0712	TFT, wiring, PCM	157°C (315°F) indicated TFT sensor circuit grounded	Voltage drop across TFT sensor exceeds scale set for temperature of 157°C (315°F).	Firm shift feel.	Go To Pinpoint Test B .

P0713	TFT, wiring, PCM	-40°C (-40°F) indicated TFT sensor circuit open	Voltage drop across TFT sensor exceeds scale set for temperature -40°C (-40°F).	Firm shift feel.	Go To Pinpoint Test B .
P1710	TFT	TFT sensor in range malfunction	PCM detected TFT not changing.	Firm shift, TCIL flashing, increase in EPC.	Go To Pinpoint Test B .
P1711	TFT	TFT out of on-board diagnostic range	Transmission not at operating temperature during on-board diagnostic.	Warm vehicle to normal operating temperature.	Go To Pinpoint Test B .
P1713	TFT wiring PCM	TFT continually reading cold	TFT sensor in range low failure.	Firm shift feel. Substitute ECT for TFT	Go To Pinpoint Test B .
P1718	TFT, wiring, PCM	TFT continually reading hot	TFT sensor in range high failure.	Firm shift feel. Substitute ECT for TFT	Go To Pinpoint Test B .
P1783	TFT	Transmission over temperature condition indicated	Transmission fluid temperature exceeded 127°C (270°F).	Increase in EPC pressure.	Go To Pinpoint Test B .
P0720	OSS	Insufficient input from output shaft speed sensor	PCM detected a loss of OSS signal during operation.	Harsh shifts, abnormal shift schedule, no torque converter clutch activation.	Go To Pinpoint Test E .
P0721	OSS	OSS sensor signal noisy	PCM has detected an erratic OSS signal.	Harsh shifts, abnormal shift schedule, no torque converter clutch engagement.	Go To Pinpoint Test E .
P0722	OSS wiring	Insufficient input from OSS	PCM has detected a loss of OSS signal.	Harsh shifts, abnormal shift schedule, no torque converter clutch engagement.	Go To Pinpoint Test E .
P0741 **	TCC, internal components	TCC slippage detected	The PCM picked up an excessive amount of slippage during normal vehicle operation.	TCC slippage/erratic or no torque converter clutch operation. Flashing Transmission Control Indicator Lamp (TCIL).	GO to Diagnosis By Symptom .
P0743 *	TCC, wiring, PCM	TCC solenoid circuit failure during on-board diagnostic	TCC solenoid circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	Short circuit: engine stalls in second (OD, 2 range) at low idle speeds with brake applied. Open circuit: torque converter clutch never engages.	Go To Pinpoint Test A .
P1746	EPC, wiring,	Shorted PCM	Voltage through	Open circuit causes	Go To Pinpoint

*	PCM	output driver	EPC solenoid is checked. An error will be noted if tolerance is exceeded.	maximum EPC pressure, harsh engagements and shifts.	Test D .
P1747 *	EPC, wiring, PCM	EPC solenoid circuit failure, shorted circuit or output driver	Voltage through EPC solenoid is checked. An error will be noted if tolerance is exceeded.	Short circuit causes minimum EPC pressure (minimum capacity) and limits engine torque (alternate firm).	Go To Pinpoint Test D .
P1760	EPC, wiring, PCM	EPC solenoid circuit failure, shorted circuit or output driver	PCM detected a loss of EPC during operation.	Unexpected reduction in engine torque.	Go To Pinpoint Test D .
P0750 a	SSA, wiring, PCM	SSA solenoid circuit failure	SSA circuit failed to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	Incorrect gear selection depending on condition mode and manual lever position. See Solenoid On/Off Chart.	Go To Pinpoint Test A .
P0753	SSA, wiring, PCM	SSA electrical circuit failure	SSA circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	Incorrect gear depending on condition mode and manual lever position. See Solenoid Off/On Chart. Flashing Transmission Control Indicator Lamp (TCIL).	Go To Pinpoint Test A .
P0751	SSA, wiring, PCM	Shift solenoid A functional failure	Mechanical or hydraulic failure of the shift solenoid.	Incorrect gear selection depending on failure mode manual lever position.	REFER to Solenoid Operation Chart. Go To Pinpoint Test A .
P0781 b	SSA or internal parts	1-2 shift error	Engine rpm drop not detected when 1-2 shift was commanded by PCM.	Incorrect gear selection depending on failure or mode and manual lever position. Shift errors may also be due to other internal transmission concerns (stuck valves, damaged friction material).	REFER to Solenoid Operation Chart. Go To Pinpoint Test A .
P1714	SSA, internal components	SSA malfunction	Mechanical failure of the solenoid detected.	Incorrect gear selection depending on condition, mode and manual lever position. See Solenoid Operation Chart.	Go To Pinpoint Test F .
P0755 a	SSB, wiring, PCM	SSB solenoid circuit failure	SSB circuit fails to provide voltage	Incorrect gear selection depending	Go To Pinpoint Test A .

			drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	on condition mode and manual lever position. See Solenoid On/Off Chart.	
P0756	SSB	Shift solenoid B functional failure	Mechanical or hydraulic failure of the shift solenoid.	Incorrect gear selection depending on failure mode and manual lever position.	REFER to Solenoid Operation Chart. Go To Pinpoint Test A .
P1715	SSB	SSB malfunction	Mechanical failure of the solenoid detected.	Incorrect gear selection depending on condition, mode and manual lever position. See Solenoid Operation Chart.	Go To Pinpoint Test F .
P0758	SSB, wiring, PCM	SSB electrical circuit failure	SSB circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	Incorrect gear depending on condition mode and manual lever position. See Solenoid Off/On Chart. Flashing Transmission Control Indicator Lamp (TCIL).	Go To Pinpoint Test A .
P0782 b	SSA, SSB or internal parts	2-3 shift error	Engine rpm drop not detected when 2-3 shift was commanded by PCM.	Incorrect gear selection depending on failure or mode and manual lever position. Shift errors may also be due to other internal transmission concerns (stuck valves, damaged friction material).	REFER to Solenoid Operation Chart. Go To Pinpoint Test A .
P0783 b	SSA, SSB or internal parts	3-4 shift error	Engine rpm drop not detected when 3-4 shift was commanded by PCM.	Incorrect gear selection depending on failure or mode and manual lever position. Shift errors may also be due to other internal transmission concerns (stuck valves, damaged friction material).	REFER to Solenoid Operation Chart. Go To Pinpoint Test A .
P1116	ECT	ECT out of on-board diagnostic range	ECT temperature higher or lower than expected during KOEO and KOER.	Rerun on-board diagnostic at normal operating temperature.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1124	TP	TP voltage high/low for on-board diagnostic	TP was not in the correct position for on-board diagnostic.	Rerun at appropriate throttle position per application.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED)

					manual.
P1460	A/C	A/C clutch cycling pressure switch error	A/C or defrost on condition may result from A/C clutch being on during on-board diagnostic.	DTC set during on-board diagnostic, repeat with A/C off. Failed on, EPC pressure slightly low with A/C OFF.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1636	PCM	PCM detected internal error	—	—	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1703	BPP	BPP switch circuit failed.	Brake ON/OFF circuit failure.	Failed ON or not connected — torque converter clutch will not engage at less than 1/3 throttle. Failed OFF or not connected — torque converter clutch will not disengage when brake is applied.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1703	BPP	Brake not actuated during on-board diagnostic	Brake not cycled during KOER.	Failed OFF or not connected — torque converter clutch will not engage at less than 1/3 throttle. Failed OFF or not connected — torque converter clutch will not disengage when brake is applied.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0740	TCC, wiring, PCM	TCC electrical circuit failure	TCC circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failed during on-board diagnostic.	Short circuit: engine stalls in second (OD, 2 range) at low idle speeds with brake applied. Open circuit: torque converter clutch never engages. Flashing Transmission Control Indicator Lamp (TCIL).	Go To Pinpoint Test A .
P1740	TCC	TCC malfunction	Mechanical failure of the solenoid detected.	Failed ON — Engine stalls in 2nd (O/D, Manual 2 ranges) at low idle speeds with brake applied. Failed OFF — Torque Converter never applies.	Go To Pinpoint Test F .
P1741 [b]	TCC, internal	Excessive torque	Excessive variations in slip	Engine rpm oscillation is	Go To Pinpoint Test A .

	components	converter clutch engagement error	(engine speed surge) across the torque converter clutch.	present in 3rd gear.	
P1742	TCC, internal components	TCC solenoid failed ON	TCC solenoid has failed on by electric, mechanical or hydraulic concern.	Harsh shifts.	Go To Pinpoint Test A .
P1743	TCC, internal components	TCC solenoid failed ON	TCC solenoid has failed ON by electric, mechanical or hydraulic concern.	Harsh shifts.	Go To Pinpoint Test A .
P1744	TCC	TCC	The PCM picked up an excessive amount of TCC slippage during normal vehicle operation.	TCC slippage/erratic or no torque converter clutch operation.	GO to Diagnosis by Symptom.
P1767	TCC	TCC solenoid circuit failure during OBD Test	TCC solenoid circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM Driver failure during OBD Test.	Short circuit: engine stalls in second (O/D, 2 range) at low idle speeds with brake applied. Open circuit: Torque Converter never engages.	Go To Pinpoint Test A .
P1780	TCS	TCS not changing states	TCS not cycled during self-test. TCS circuit open or shorted.	Rerun on-board diagnostic and cycle switch. No OD cancel when switch is cycled.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
—	TCIL	TCIL circuit failure	TCIL circuit open or shorted.	Failed on, OD cancel mode on. No flashing TCIL for EPC failure or sensor. Failed off, OD cancel mode never indicated. No flashing TCIL for EPC sensor failure.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual
P1709	PNP switch	PNP switch out of self-test range	Vehicle not in PARK or NEUTRAL during on-board diagnostic.	Rerun on-board diagnostic in PARK or NEUTRAL.	Go To Pinpoint Test C .

[a] Output circuit check, generated only by electrical symptoms.
[b] May also be generated by some other non-electric transmission hardware system.

Rotunda Transmission Tester

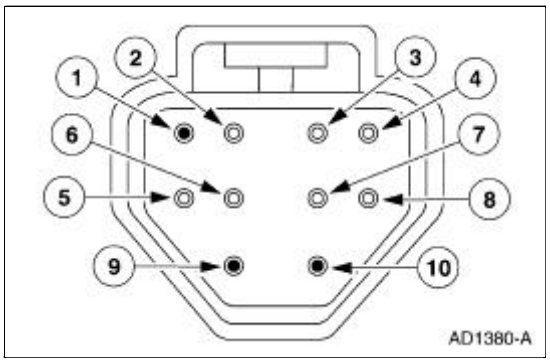
The Transmission Tester is used to diagnosis the digital transmission range sensor and is used in conjunction with the pinpoint tests. The tests should be carried out in order. Installing the Transmission Tester allows separation of the vehicle electronics from transmission electronics; refer to the Transmission Tester manual for these tests.

- Digital Transmission Range (TR) Sensor Testing

- Resistance/Continuity Test
- Voltage Test - PARK/NEUTRAL, Reversing Lamp, and Optional Circuits

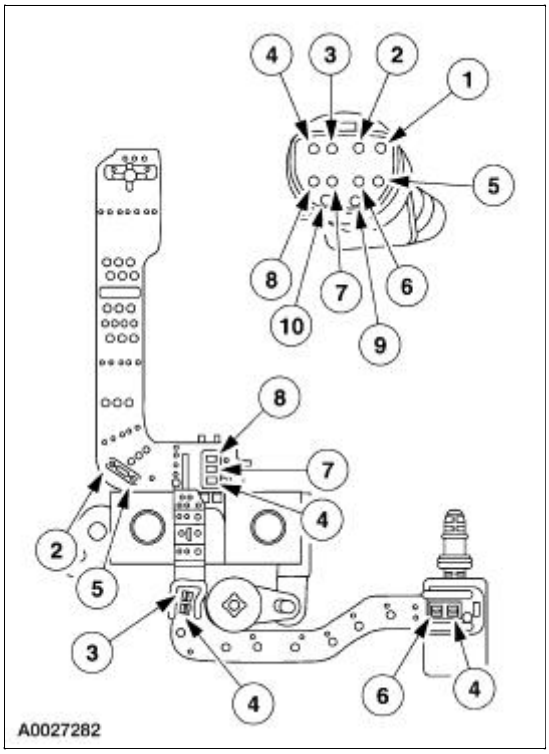
Transmission Connector Layouts

Transmission Vehicle Harness Connector



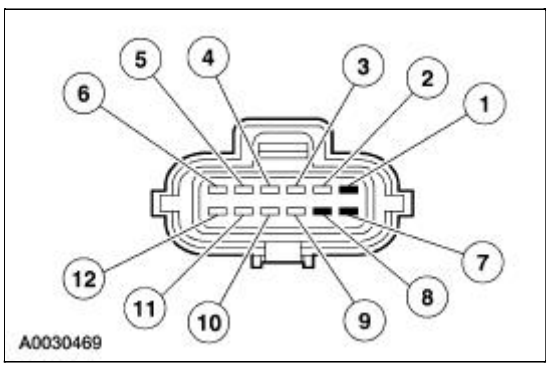
Pin Number	Circuit	Circuit Function
1	—	NOT USED
2	—	Signal Return
3	—	Torque Converter Clutch (TCC) Solenoid
4	—	Vehicle Power
5	—	Transmission Fluid Temperature (TFT) Input
6	—	Electronic Pressure Control (EPC) Solenoid
7	—	SSA
8	—	SSB
9	—	NOT USED
10	—	NOT USED

Transmission Internal Harness Connector



Pin Number	Circuit	Circuit Function
1	—	NOT USED
2	—	Signal Return Transmission Fluid Temperature (TFT)
3	—	Torque Converter Clutch (TCC)
4	—	Vehicle Power To Solenoid
5	—	Transmission Fluid Temperature (TFT)
6	—	Electronic Pressure Control
7	—	SSA
8	—	SSB
9	—	NOT USED
10	—	NOT USED

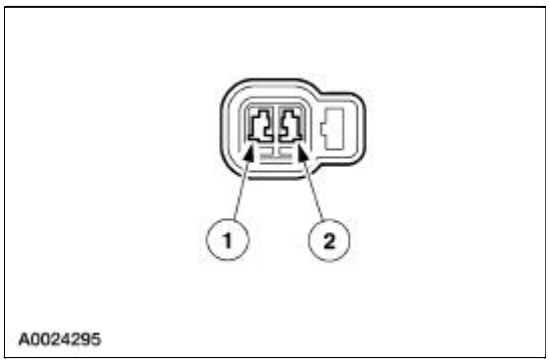
Digital Transmission Range (TR) Sensor Connector



Pin Number	Circuit	Circuit Function

1	—	NOT USED
2	—	Signal Return
3	—	TR3A
4	—	TR1
5	—	TR2
6	—	TR4
7	—	NOT USED
8	—	NOT USED
9	—	Fused Power Feed
10	—	Starter Control
11	—	Reverse
12	—	Starter to Starter Interrupt Relay

Output Shaft Speed (OSS) Sensor Harness Connector



Pin Number	Circuit	Circuit Function
1	—	Output Shaft Speed (OSS) Sensor
2	—	Signal Return

Digital Transmission Range (TR) Sensor Diagnosis Chart

Selector Position	PID: TR	PID: TR_D				PID: TR_V (volts)
		TR4	TR3A	TR2	TR1	TR3A (PCM Pin 64 to sigrtn)
PARK	P/N	0	0	0	0	0.0 Volts
In Between	REV	0	1	0	0	1.3 - 1.8 Volts
REVERSE	REV	1	1	0	0	1.3 - 1.8 Volts
In Between	REV	0	1	0	0	1.3 - 1.8 Volts
NEUTRAL	NTRL	0	1	1	0	1.3 - 1.8 Volts
In Between	O/D [a]	1	1	1	0	1.3 - 1.8 Volts
OVERDRIVE	O/D [a]	1	1	1	1	1.3 - 1.8 Volts
In Between	Man 2	1	0	1	1	0.0 Volts

Manual 2	Man 2	1	0	0	1	0.0 Volts
In Between	Man 2	1	0	1	1	0.0 Volts
Manual 1	Man 1	0	0	1	1	0.0 Volts

[a] Will read "Drive" if O/D is canceled.

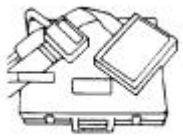
A. TR_V is the voltage at the PCM pin 64 (TR3A Circuit) to signal return.
B. "In Between" reading could be caused by a shift cable or digital TR sensor misaligned or a digital TR sensor circuit failure of TR1, TR2, TR3A, or TR4.
C. TR_D: 1= Open Digital TR switch, 0= Closed Digital TR switch.
D. EEC-V Control System Breakout Box Readings: Taken from PCM signal pins for TR1, TR2, TR3A, TR4 to signal return.
    - **Voltages for TR1, TR2, TR4:**
    - 0 = 0.0 volts.
    - 1 = 9.0 - 14.0 volts.
    - **Voltage for TR3A:**
    - 0 = 0.0 volts.
    - 1 = 1.3 - 1.8 volts.

Wiggle Test Information For Open/Shorts

- TR4, TR3A, TR2, and TR1 are all closed in PARK. PARK is a good position to check for intermittent open circuits (with scan tool monitoring TR_D).
- TR4, TR3A, TR2, and TR1 are all open in OVERDRIVE, so OVERDRIVE is a good position to check for shorts to ground. To determine the shorted components while observing TR_D, unplug the TR and see if the short goes away. If the short is still present, unplug the transmission harness and see if the short goes away. If the short is still present, then the short is in the PCM or vehicle harness. Remove the suspect circuit(s) wire from the PCM vehicle harness. If the short is still present, then the PCM has an internal failure. Otherwise the failure is in the vehicle harness.

Pinpoint Tests — OSC Equipped Vehicles

Special Tool(s)

 ST1391-A	Breakout Box, EEC-V Control System 418-049 (T94L-50-EEC-V) or equivalent
ST1632-A	MLP-TR Cable 418-F107 (007-00111) or equivalent
ST2332-A	Worldwide Diagnostic System (WDS) 418–F224 New Generation STAR (NGS) Tester 418-F052 or equivalent scan tool
ST1389-A	Transmission Tester 307-F016 (007-00130) or equivalent
	Trans Tester TR/MLP Overlay and Manual 007-00131 or equivalent
ST1137-A	73 III Automotive Meter 105-R0057 or equivalent
ST2545-A	Gauge, Transmission Solenoid Connectors 307-426

Any time an electrical connector or solenoid body is disconnected, inspect the connector for pin condition, corrosion and contamination. Also inspect the connector seal for damage. Clean, repair or install a new connector as required.

Shift Solenoids Pre-Diagnosis

Use the following shift solenoid operation information when carrying out Pinpoint Test A.

Solenoid Operation Chart

Gear Lever Position	PCM Commanded Gear	Solenoids		
		SSA	SSB	TCC
P/R/N	1	ON	OFF	HD
(D)	1	ON	OFF	HD
(D)	2	OFF	OFF	EC
(D)	3	OFF	ON	EC
(D)	4	ON	ON	EC
(D)				
w/OD OFF				
1	1	ON	OFF	HD
2	2	OFF	OFF	EC
3	3	OFF	ON	EC
Manual 2	2	OFF	OFF	EC
Manual 1	1	ON	OFF	HD
1 [a]	2	OFF	OFF	EC

[a] When a manual pull-in occurs above a calibrated speed the transmission will downshift from the higher gear until the vehicle speed drops below this calibrated speed.

EC = Electronically controlled.

HD = Hydraulically disabled.

Shift Solenoid Failure Mode Chart "Always Off"

Failed off due to powertrain control module and or vehicle wiring concerns, shift solenoid electrically or hydraulically stuck off.

SSA ALWAYS OFF:	Gear Lever Position		
	(D)	2	1
PCM Gear Commanded	**Actual Gear Obtained**		
1	2	2	2
2	2	2	2
3	3	2 [a]	2 [a]
4	3	2 [a]	2 [a]

[a] No engine braking.

SSB ALWAYS OFF:	Gear Lever Position		
	(D)	2	1
PCM Gear Commanded	Actual Gear Obtained		
1	1	1	1
2	2	2	2
3	2	2	2
4	1	1	1

Shift Solenoid Failure Mode Chart "Always On"

Failed on due to powertrain control module and or vehicle wiring concerns, shift solenoid electrically or hydraulically stuck on.

SSA ALWAYS ON:	Gear Lever Position		
	(D)	2	1
PCM Gear Commanded	Actual Gear Obtained		
1	1	1	1
2	1	1	1
3	4	2 [a]	2 [a]
4	4	2 [a]	2 [a]

[a] No engine braking.

SSB ALWAYS ON:	Gear Lever Position		
	(D)	2	1
PCM Gear Commanded	Actual Gear Obtained		
1	4	2 [a]	2 [a]
2	3	2 [a]	2 [a]
3	3	2 [a]	2 [a]
4	4	2 [a]	2 [a]

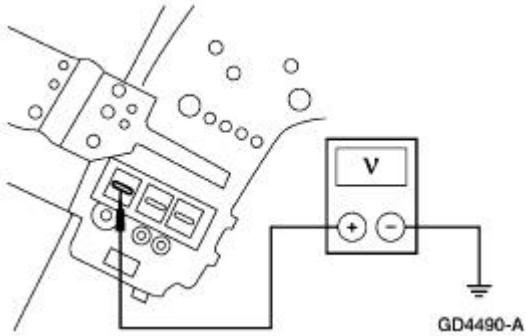
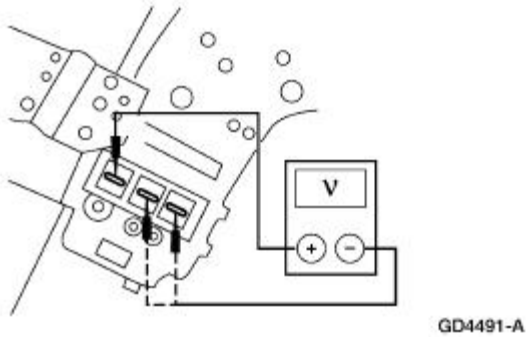
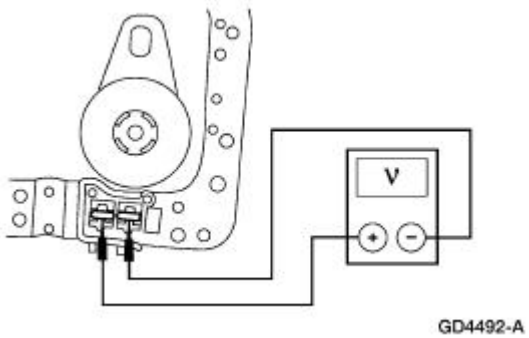
[a] No engine braking.

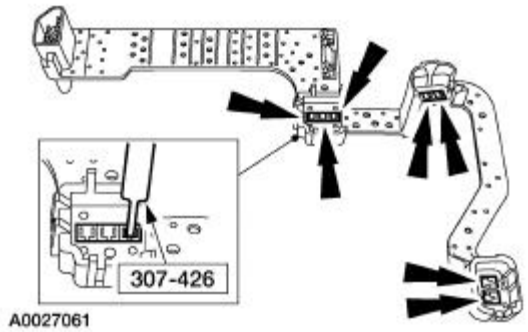
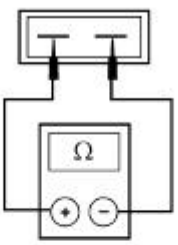
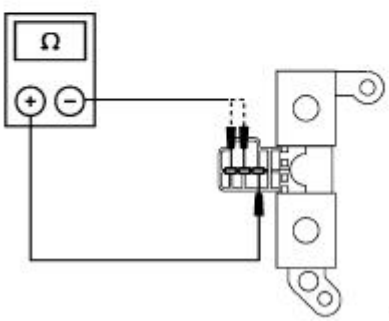
PINPOINT TEST A: SHIFT AND TORQUE CONVERTER CLUTCH SOLENOIDS

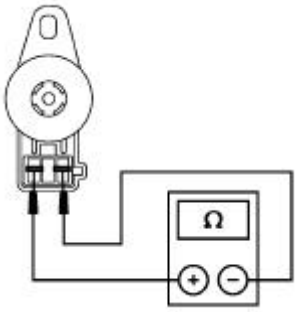
Test Step	Result / Action to Take
NOTE: Read and record all DTCs. All digital TR Sensor and VSS DTCs must be repaired before entering Output State Control (OSC).	
NOTE: Refer to the Transmission Internal Harness illustration preceding these pinpoint tests.	

NOTE: Refer to the Transmission Vehicle Harness Connector illustration preceding these pinpoint tests.

A1 ELECTRONIC DIAGNOSTICS	
• Select PARK. • Key in OFF position. • Check to make sure the transmission harness connector is fully seated, pins are fully engaged in connector and in good condition before proceeding. • Connect the diagnostic tool. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Diagnostic Data Link. • Enter the following diagnostic mode on the diagnostic tool: PCM. • Enter the following diagnostic mode on the diagnostic tool: Active Command Modes. • Enter the following diagnostic mode on the diagnostic tool: Output State Control (OSC). • Enter the following diagnostic mode on the diagnostic tool: Trans-Bench Mode. • **Does vehicle enter Trans-Bench Mode?**	**Yes** GO to A2 . **No** REPEAT procedure to enter Trans-Bench Mode. If vehicle did not enter Trans-Bench Mode, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of PCM.
A2 WIGGLE TEST	
• Select PIDs to be monitored. **PID Command** / **PID Actual** SSA / SS1F SSB / SS2F TCC / TCCF • Select "ON" to turn suspect solenoid on. • Press "SEND". • Wiggle all wiring and connectors to the transmission. Monitor the Solenoid State for changes. • Select "OFF" to turn solenoid off. • Press "SEND". • **Does the suspect solenoid(s) fault state change?**	**Yes** REPAIR open or short in the vehicle harness or connector. **No** GO to A3 .
A3 SOLENOID FUNCTIONAL CHECK	
• Monitor each solenoid state. • Turn each solenoid ON and OFF. • **Does the solenoid turn ON and OFF when commanded and can solenoid activation be heard?**	**Yes** GO to A4 . **No** GO to A5 .
A4 OSC TRANS-DRIVE MODE (GR_CM OR TCC)	
• Carry out OSC Trans-Drive Mode. • Select GR_CM for Shift Solenoids or follow procedures for GR_CM as listed. • Select TCC for Torque Converter Clutch Solenoid. Follow procedures of TCC in Drive Mode as listed. • **Does the transmission upshift and downshift or torque converter engage/disengage when commanded?**	**Yes** CLEAR all DTCs. ROAD TEST to verify if concern is still present. If concern is still present, REFER to Diagnosis By Symptom in this section to diagnose shift or torque converter concern. **No** GO to A5 .
A5 CHECK FOR BATTERY VOLTAGE	
• Remove transmission fluid pan.	**Yes**

• Visually inspect the lead frame and connectors for damage. • Key in ON position. • Measure the voltage with the positive lead to VPWR solenoid pin and negative lead to a good ground.  • **Is the voltage greater than 10 volts?**	GO to A6 . **No** CHECK for open or short circuit in harness, or solenoid.
A6 ELECTRICAL SIGNAL CHECK	
• Measure the voltage with the positive lead connected to VPWR solenoid pin and the negative lead to the signal pin of the appropriate solenoid.  • Enter the following diagnostic mode on the diagnostic tool: Trans-Bench Mode. • Select Parameter SSA, SSB or TCC. • Select "ON". • Press "SEND". • Turn the solenoids ON and OFF, while monitoring the voltage, solenoid state on the scan tool (ON and OFF), and listen for the solenoid to activate (click). • Measure the voltage with the positive lead to VPWR pin and the negative lead to the TCC pin.  • Enter the following diagnostic mode on the diagnostic tool: Select Parameter TCC. • Select "ON". • Press "SEND". • Turn the solenoid ON and OFF, while monitoring the voltage, solenoid state on the scan tool (ON and OFF),	**Yes** GO to A7 . **No** CHECK for open or short circuit in harness, solenoid or a PCM concern.

and listen for the solenoid to activate (click). ● Select "OFF", press "SEND". ● **Does the voltage and solenoid state change?**	
A7 CHECK LEAD FRAME CONNECTIONS	
● Key in OFF position. ● Disconnect: Lead Frame. ● Inspect for damaged or pushed out pins, corrosion, ect. ● Using the special tool, check each of the lead frame connector pins.  A0027061 ● **Does the special tool go through the lead frame connector pins?**	**Yes** INSTALL a new lead frame. GO to A8 . **No** GO to A8 .
A8 CHECK SOLENOID RESISTANCE AT SOLENOID	
● Key in OFF position. ● Disconnect the appropriate solenoid from the lead frame. ● Measure the solenoid resistance between the pins of the solenoid.  GD3386-A  AD1391-A	**Yes** GO to A9 . **No** INSTALL a new solenoid.



AD1392-A

- Measure the resistance for each solenoid (SSA, SSB or TCC) as follows:

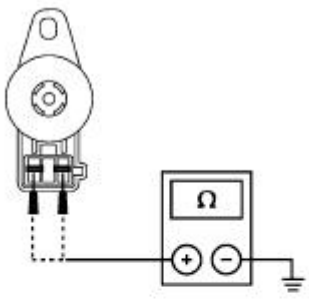
Solenoid	Resistance (ohms)
SSA	20-30
SSB	20-30
TCC	10-16

- **Are the resistances correct?**

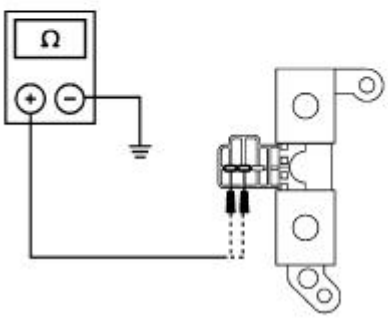
A9 CHECK SOLENOID FOR SHORT TO GROUND

- Check for continuity between engine ground and appropriate solenoid pin with ohmmeter or other low current tester. Connection should show infinite resistance (no continuity).

Solenoid	Terminal
SSA	+/-
SSB	+/-
TCC	+/-



AD1393-A



AD1394-A

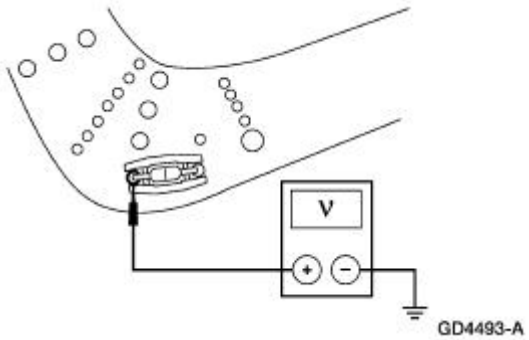
- **Is there continuity?**

Yes
INSTALL a new solenoid.

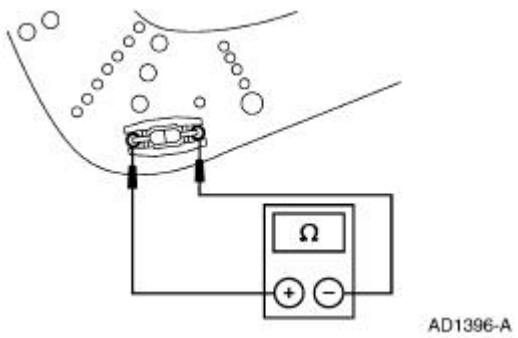
No
REFER to Diagnosis By Symptom in this section for diagnosis of shift or torque converter concerns.

PINPOINT TEST B: TRANSMISSION FLUID TEMPERATURE (TFT) SENSOR

Test Step	Result / Action to Take
NOTE: Refer to the Transmission Connector Layouts preceding these pinpoint tests.	
B1 ELECTRONIC DIAGNOSTICS ● Check to make sure the transmission harness connector is fully seated, pins are fully engaged in connector and in good condition before proceeding. ● Connect the diagnostic tool. ● Key in ON position. ● Select Diagnostic Data Link. ● Select PCM. ● Select PID/Data Monitor and Record. ● Enter the following diagnostic mode on the diagnostic tool: PIDs; TFT, TFTV. ● **Does the vehicle enter PID/Data Monitor and Record?**	**Yes** GO to B2 . **No** REPEAT procedure to enter PID. If vehicle did not enter PID, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of PCM.
B2 WARM-UP/COOL-DOWN CYCLE ● While monitoring the TFT PIDs, carry out the following test: If transmission is cold, run transmission to warm it up. If transmission is warm, allow transmission to cool down. ● **Do the TFT PIDs increase as the transmission is warmed up or decrease as the transmission is cooled or does the TFT or TFTV drop in and out of range?**	**Yes** If the TFT PIDs increase as the transmission is warmed or decrease as the transmission is cooled, CLEAR all DTCs. ROAD TEST to verify if concern is still present. If concern is still present, REFER to Diagnosis By Symptom in this section to diagnose transmission overheating. If the TFT or TFTV drop in and out of range, INSPECT for intermittent concern in the internal/external harness, sensor or connector. **No** GO to B3 .
B3 ELECTRICAL SIGNAL CHECK ● Key in ON position. ● Remove transmission fluid pan. ● Visually inspect the lead frame and connectors for damage. ● Measure the voltage with the positive lead to positive TFT at sensor pin and negative lead to a good ground.	**Yes** GO to B4 . **No** CHECK for open or short circuit in vehicle harness, internal harness or a PCM concern.



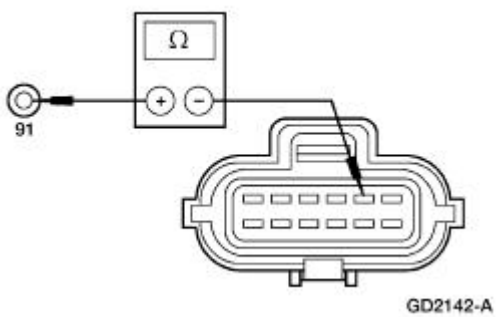
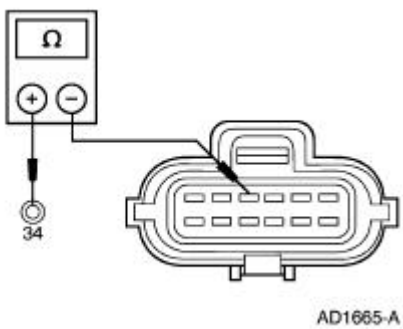
- **Is the voltage present?**

B4 CHECK RESISTANCE OF TFT SENSOR	
• Disconnect: Transmission Harness . • Measure the resistance between the positive TFT and negative TFT pins at transmission connector, using the following: **Transmission Fluid Temperature** **°C** / **°F** / **Resistance (Ohms)** -40 to -20 / -40 to -4 / 967K - 284K -19 to -1 / -3 - 31 / 284K - 100K 0 - 20 / 32 - 68 / 100K - 37K 21 - 40 / 69 - 104 / 37K - 16K 41 - 70 / 105 - 158 / 16K - 5K 71 - 90 / 159 - 194 / 5K - 2.7K 91 - 110 / 195 - 230 / 2.7K - 1.5K 111 - 130 / 231 - 266 / 1.5K - 0.8K 131 - 150 / 267 - 302 / 0.8K - 0.54K  • **Is the resistance correct?**	**Yes** REFER to Diagnosis By Symptom in this section to diagnose an overheating concern. **No** INSTALL a new internal harness (sensor is part of harness).

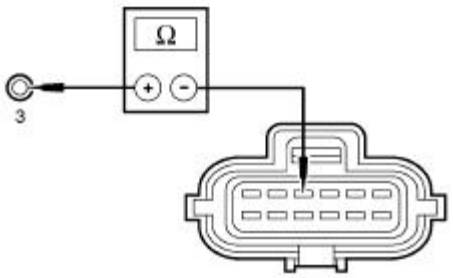
PINPOINT TEST C: DIGITAL TRANSMISSION RANGE (TR) SENSOR

Test Step	Result / Action to Take
NOTE: Refer to the Digital Transmission Range (TR) Sensor Connector illustration preceding these pinpoint tests.	
NOTE: Refer to the Digital Transmission Range (TR) Sensor Diagnosis Chart preceding these pinpoint tests.	

C1 VERIFY DIAGNOSTIC TROUBLE CODES	
• Select PARK. • Key in OFF position. • **NOTE:** DTC codes P0705 and P0708 cannot be set by an incorrectly adjusted digital TR sensor. • Carry out on board diagnostic test. • **Are only DTC codes P0705, P0708 present?**	**Yes** GO to C4 . **No** GO to C2 .
C2 VERIFY DIGITAL TRANSMISSION RANGE SENSOR ALIGNMENT	
• Check to make sure the digital TR sensor harness connector is fully seated, pins are fully engaged in connector and in good condition before proceeding. • Apply the parking brake. • Select NEUTRAL. • Disconnect the shift cable/linkage from the manual lever. • Verify that the digital TR Sensor Alignment Tool fits in the appropriate slots. • **Is the digital TR sensor adjustment OK?**	**Yes** GO to C3 . **No** ADJUST the digital TR sensor. PLACE transmission range selector lever in P and CLEAR DTCs. REPEAT OBD Tests.GO to C3 .
C3 VERIFY SHIFT CABLE/LINKAGE ADJUSTMENT	
• Place the manual lever in the overdrive position. • Select DRIVE. • Reconnect the shift cable/linkage. • Verify that the shift cable/linkage is adjusted OK. Refer to Section 307-05 . • **Is the shift cable/linkage adjusted OK?**	**Yes** GO to C4 . **No** ADJUST the shift cable/linkage. REFER to Section 307-05 .
C4 CHECK ELECTRICAL SIGNAL OPERATION	
• Select PARK. • Disconnect: Digital TR Sensor. • **CAUTION: Do not pry on connector. This will damage the connector and result in a transmission concern.** • Press the button and pull out on the digital TR harness connector. • Inspect both ends of the connector for damage or pushed-out pins, corrosion, loose wires and missing or damaged seals. • **Are the connector, pins and harness damaged?**	**Yes** REPAIR as required. CLEAR DTCs and REPEAT OBD Tests. **No** If diagnosing a DTC, GO to C5 . If diagnosing a starting concern or a reversing lamp concern, GO to C10 .
C5 CHECK ELECTRICAL SYSTEM OPERATION (DIGITAL TR AND PCM)	
• Key in OFF position. • Connect the diagnostic tool. • Connect: Digital TR Sensor. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: TR PIDS TR, TR_D, TR_V. • Move transmission range selector lever into each gear and stop. • Observe any of the following PIDs, TR and TR_D, TR_V (vehicle dependent) while wiggling harness, tapping on sensor, or driving the vehicle. Use PIDs TR, and TR_D for DTCs P0705, P1704, and P1705. Use PIDs TR, and TR_V for DTC P0708. • Compare the PIDs to the Digital Transmission Range (TR) Sensor Diagnosis Chart. • **Do the PIDs TR, TR_D and TR_V match the Digital Transmission Range (TR) Sensor Diagnosis chart, and does the TR_D PID remain steady when the**	**Yes** The problem is not in the digital TR sensor system. REFER to Diagnosis By Symptom in this section for further diagnosis. **No** If TR_D changes when wiggling harness, tapping on the sensor, or driving the vehicle, the problem may be intermittent. GO to C6 .

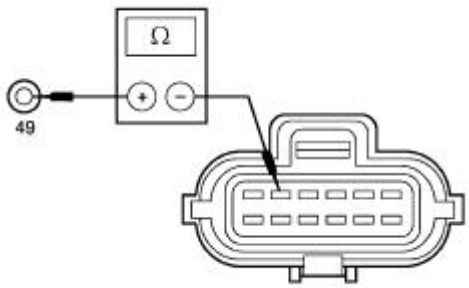
harness is wiggled, the sensor is tapped, or the vehicle driven?	
C6 CHECK DIGITAL TRANSMISSION RANGE SENSOR OPERATION	
• Disconnect: Digital TR Sensor . • **CAUTION: Do not pry on connector. This will damage the connector and result in a transmission concern.** • Connect: TR-E Cable to Transmission Tester. • Connect: TR-E Cable to Digital TR Sensor. • Place the Digital TR Overlay onto Transmission Tester. • Carry out Sensor Test as instructed on the Digital TR Overlay. • **Does the status lamp on the tester TRS-E cable match the selected gear positions?**	**Yes** Concern is not in the digital TR sensor, GO to C7 . **No** INSTALL a new digital TR sensor. CLEAR DTCs and REPEAT OBD Tests.
C7 CHECK PCM HARNESS CIRCUITS FOR OPENS	
• Key in OFF position. • Disconnect: Powertrain Control Module (PCM) . • Inspect for damaged or pushed-out pins, corrosion or loose wires. • Disconnect: Digital TR Sensor. • **CAUTION: Do not pry the connector. This will damage the connector and result in a transmission concern.** • Disconnect the digital TR sensor connector. • Install the EEC-V Control System Breakout Box. • Measure the resistance between the PCM test pin 91 at the EEC-V Control System Breakout Box and signal return circuit pin 2 at digital TR sensor connector harness side.  GD2142-A • For vehicles equipped with a 4.6L engine measure the resistance between the PCM test pin 34 at the EEC-V Control System Breakout Box and TR1 circuit pin 4 at digital TR sensor connector harness side.  AD1665-A • For vehicles equipped with a 3.8L engine measure the resistance between the PCM test pin 3 at the EEC-V	**Yes** GO to C8 . **No** REPAIR open circuit(s). RECONNECT all components. CLEAR DTCs. REPEAT OBD Tests.

Control System Breakout Box and TR1 circuit pin 4 at digital TR sensor connector harness side.



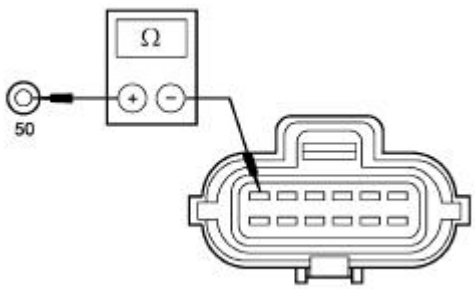
A0008651

- Measure the resistance between the PCM test pin 49 at the EEC-V Control System Breakout Box and TR2 circuit pin 5 at digital TR sensor connector harness side.



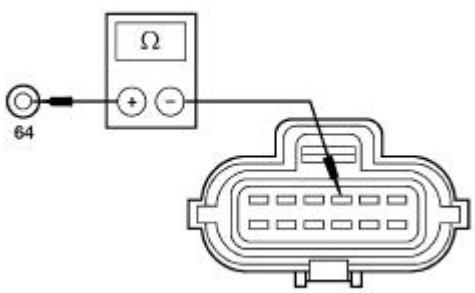
GD2144-A

- Measure the resistance between the PCM test pin 50 at the EEC-V Control System Breakout Box and TR4 circuit pin 6 at digital TR sensor connector harness side.



GD2145-A

- Measure the resistance between the PCM test pin 64 at the EEC-V Control System Breakout Box and TR3A circuit pin 3 at digital TR sensor connector harness side.

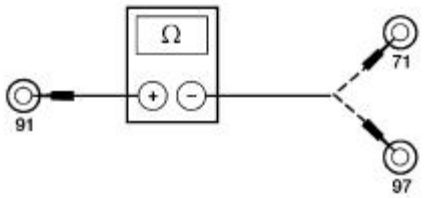


GD2146-A

- **Are all resistances less than 5 ohms?**

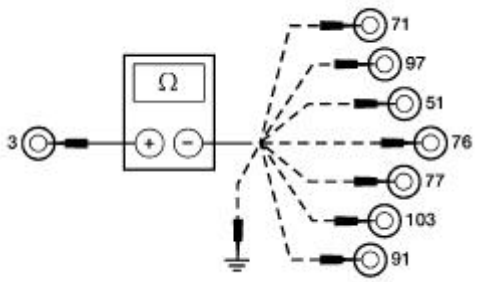
C8 CHECK PCM HARNESS CIRCUITS FOR SHORT TO GROUND OR POWER	
• Measure the resistance between PCM test pin 91 and	**Yes**

test pins 71 and 97 at the EEC-V Control System Breakout Box.



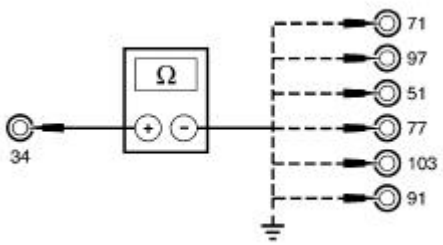
GD2254-A

- For vehicles equipped with a 3.8L engine measure the resistance between PCM test pin 3 and test pins 71, 97, 51, 76, 77, 103, and 91 at the EEC-V Control System Breakout Box and chassis ground.



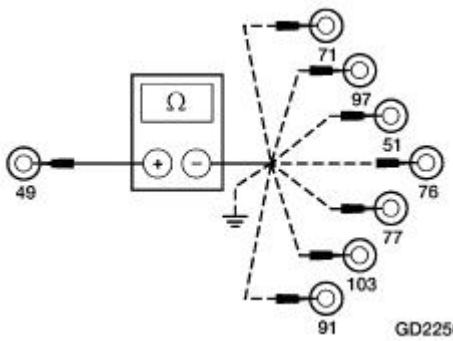
GD4496-A

- For vehicles equipped with a 4.6L engine measure the resistance between PCM test pin 34 and test pins 71, 97, 51, 77, 103, and 91 at the EEC-V Control System Breakout Box and chassis ground.



A0008652

- For vehicles equipped with a 3.8L engine measure the resistance between PCM test pin 49 and test pins 71, 97, 51, 76, 77, 103, and 91 at the EEC-V Control System Breakout Box and chassis ground.



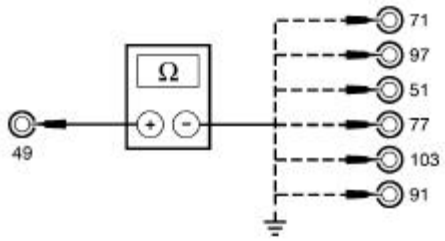
GD2256-A

- For vehicles equipped with a 4.6L engine measure the resistance between PCM test pin 49 and test pins 71,

GO to C9 .

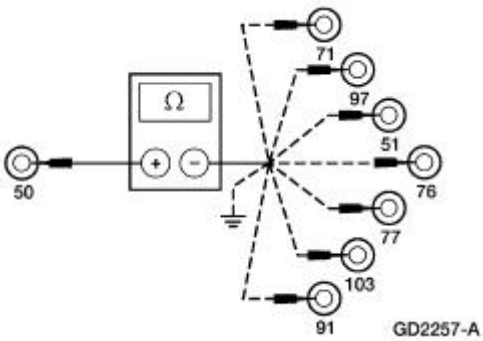
No
REPAIR short circuit(s). RECONNECT all components. CLEAR DTCs. REPEAT OBD Tests.

97, 51, 77, 103, and 91 at the EEC-V Control System Breakout Box and chassis ground.

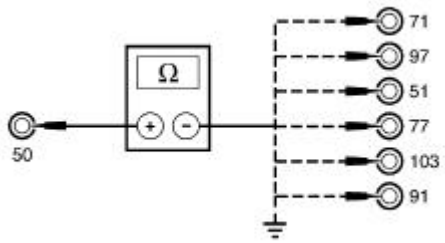


A0008653

- For vehicles equipped with a 3.8L engine measure the resistance between PCM test pin 50 and test pins 71, 97, 51, 76, 77, 103, and 91 at the EEC-V Control System Breakout Box and chassis ground.

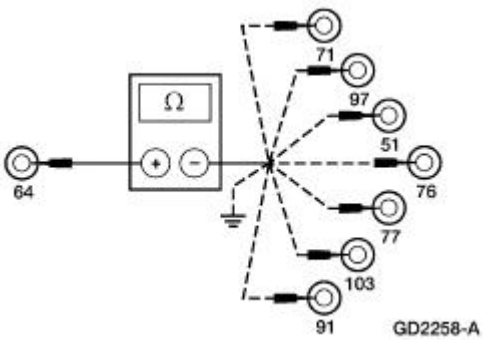


- For vehicles equipped with a 4.6L engine measure the resistance between PCM test pin 50 and test pins 71, 97, 51, 77, 103, and 91 at the EEC-V Control System Breakout Box and chassis ground.

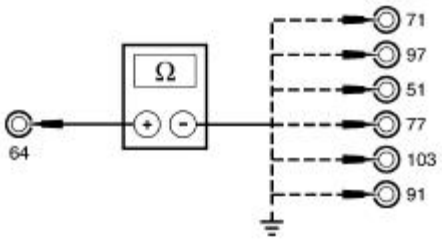
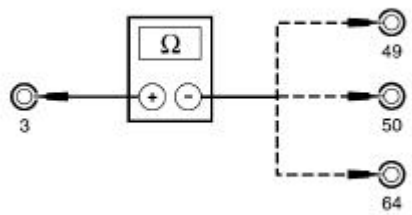
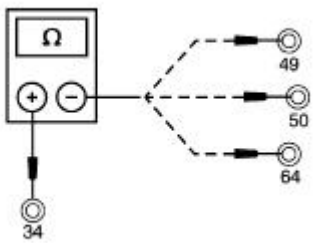
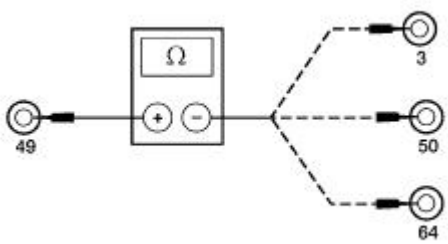


A0008654

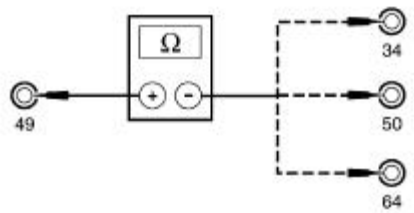
- For vehicles equipped with a 3.8L engine measure the resistance between PCM test pin 64 and test pins 71, 97, 51, 76, 77, 103, and 91 at the EEC-V Control System Breakout Box and ground.



- For vehicles equipped with a 4.6L engine measure the resistance between PCM test pin 64 and test pins 71,

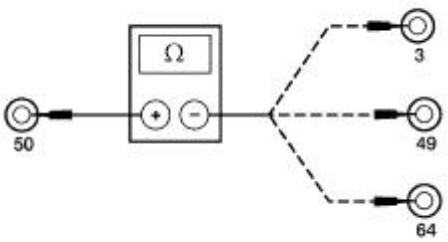
97, 51, 77, 103, and 91 at the EEC-V Control System Breakout Box and chassis ground.  A0008655 ● **Are all resistances greater than 10,000 ohms?**	
C9 CHECK FOR SHORT BETWEEN TR/PCM INPUT SIGNAL CIRCUITS ● For vehicles equipped with a 3.8L engine measure the resistance between test pin 3 and pins 49, 50, and 64 at the EEC-V Control System Breakout Box.  A0008656 ● For vehicles equipped with a 4.6L engine measure the resistance between test pin 34 and pins 49, 50, and 64 at the EEC-V Control System Breakout Box.  AD1666-A ● For vehicles equipped with a 3.8L engine measure the resistance between test pin 49 and pins 3, 50, and 64 at the EEC-V Control System Breakout Box.  GD2260-A ● For vehicles equipped with a 4.6L engine measure the	**Yes** INSTALL a new PCM. REFER to Section 303-14 . RECONNECT all components. CLEAR DTCs. REPEAT OBD Tests. **No** REPAIR shorts on circuits having less than 10,000 ohms between other TR/PCM input signal circuits. RECONNECT all components. CLEAR DTCs. REPEAT OBD Tests.

resistance between test pin 49 and pins 34, 50, and 64 at the EEC-V Control System Breakout Box.



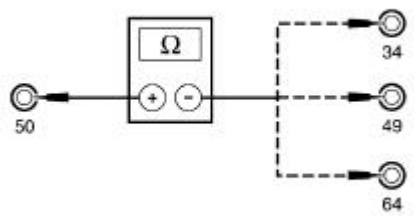
A0008659

- For vehicles equipped with a 3.8L engine measure the resistance between test pin 50 and pins 3, 49, and 64 at the EEC-V Control System Breakout Box.



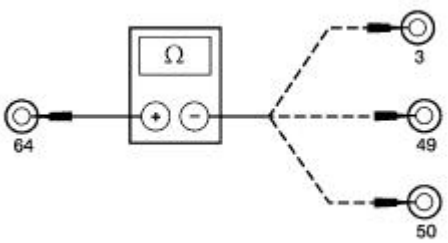
GD2261-A

- For vehicles equipped with a 4.6L engine measure the resistance between test pin 50 and pins 34, 49, and 64 at the EEC-V Control System Breakout Box.



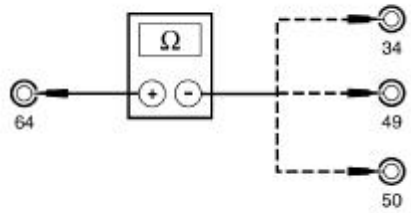
A0008657

- For vehicles equipped with a 3.8L engine measure the resistance between test pin 64 and pins 3, 49, and 50 at the EEC-V Control System Breakout Box.



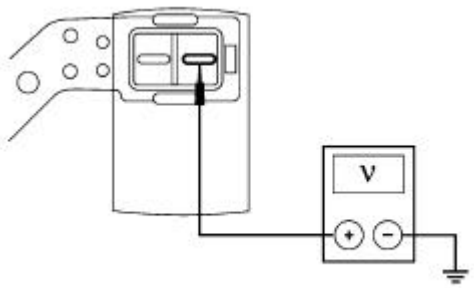
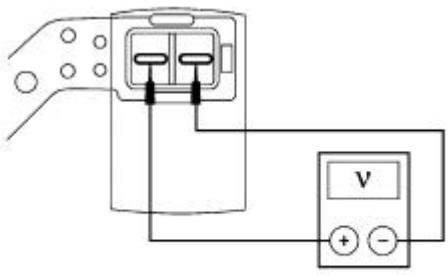
GD2262-A

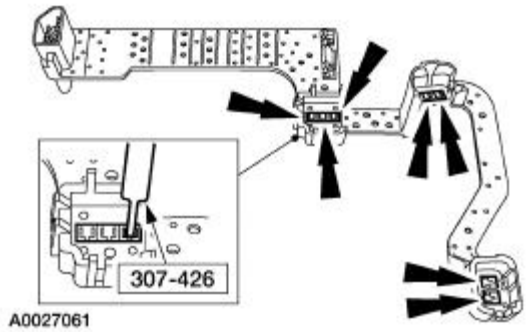
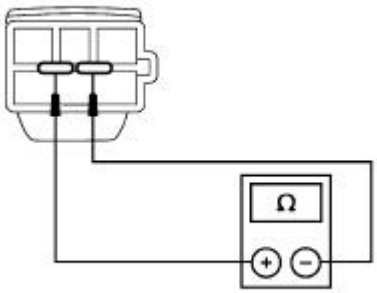
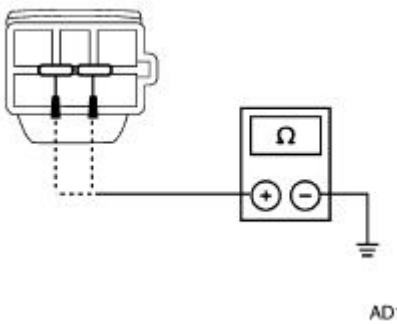
- For vehicles equipped with a 4.6L engine measure the resistance between test pin 64 and pins 34, 49, and 50 at the EEC-V Control System Breakout Box.

 A0008658 ● **Are all the resistances greater than 10,000 ohms?**	
C10 CHECK THE NON-PCM INTERNAL CIRCUITS OF SENSOR	
● Connect: TRS-E Cable to Transmission. ● Connect: TRS-E Cable to Digital TR Sensor. ● Place the Digital TR Overlay onto Transmission Tester. ● Carry out Switch Test as instructed on the Digital TR Overlay. ● **Does the status lamp on the tester indicate RED for the correct gear position?**	**Yes** Concern is not in the digital TR sensor. For starting system concerns, REFER to Section 303-06 . For reversing lamp concerns, REFER to Section 417-01 . For optional circuits, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. **No** INSTALL a new digital TR sensor. CLEAR DTCs. REPEAT OBD Tests.

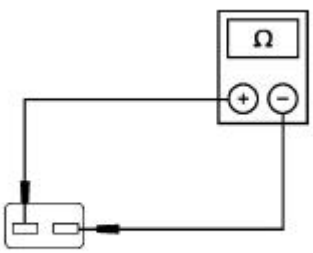
PINPOINT TEST D: ELECTRICAL PRESSURE CONTROL (EPC) SOLENOID

Test Step	Result / Action to Take
NOTE: Refer to the Transmission Internal Harness illustration preceding these pinpoint tests.	
NOTE: Read and record all DTCs. All digital TR Sensor and VSS DTCs must be repaired before entering Output State Control (OSC).	
D1 ELECTRONIC DIAGNOSTICS	
● Key in OFF position. ● Select PARK. ● Check to make sure the transmission harness connector is fully seated, pins are fully engaged in the connector and in good condition before proceeding. ● Connect the diagnostic tool. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Diagnostic Data Link. ● Enter the following diagnostic mode on the diagnostic tool: PCM. ● Enter the following diagnostic mode on the diagnostic tool: Active Command Modes. ● Enter the following diagnostic mode on the diagnostic tool: Output State Control (OSC). ● Enter the following diagnostic mode on the diagnostic tool: Trans-Bench Mode. ● **Does the vehicle enter the Trans-Bench Mode?**	**Yes** GO to D2 . **No** REPEAT procedure to ENTER Trans-Bench Mode. If vehicle did not enter OSC, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of PCM.

D2 SOLENOID FUNCTIONAL TEST	
• Install 2,060 kPa (300 psi) pressure gauge into EPC tap. • Monitor pressure gauge. • Enter the following diagnostic mode on the diagnostic tool: Parameter; EPC. • Select value - 15, 30, 45, 60, 70 or 90 psi. • Press "SEND". • Select another value "0-90 psi". • Press "SEND". • Enter the following diagnostic mode on the diagnostic tool: XXX. • Press "SEND". • **Does the pressure reading match the commanded pressure?**	**Yes** CLEAR DTCs. REPEAT OBD Tests. **No** GO to D3 .
D3 CHECK FOR BATTERY VOLTAGE	
• Remove transmission fluid pan. • Visually inspect the lead frame connectors for damage. • Key in ON position. • Measure the voltage with positive lead to VPWR solenoid pin and negative lead to a good ground.  GD4494-A • **Is voltage greater than 10 volts?**	**Yes** GO to D4 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the OBD Tests.
D4 ELECTRICAL SIGNAL CHECK	
• Measure the voltage with positive lead connected to VPWR solenoid pin and connect negative lead to the signal pin of the EPC solenoid.  GD4495-A • Turn the solenoids ON and OFF, while monitoring the voltage reading, solenoid state on the scan tool (ON and OFF), listen for the solenoid to activate (click). • Enter the following diagnostic mode on the diagnostic tool: Trans-Bench Mode. • Enter the following diagnostic mode on the diagnostic tool: Parameter EPC. • Select a value "0-90 psi". • Press "SEND". • Select another value "0-90 psi". • Press "SEND". • Enter the following diagnostic mode on the diagnostic tool:	**Yes** GO to D5 . **No** CHECK for open or short circuit in harness or PCM.

XXX. ● Press "SEND". ● **Does the voltage and solenoid state change?**	
D5 CHECK LEAD FRAME CONNECTIONS	
● Key in OFF position. ● Disconnect: Lead Frame. ● Inspect for damaged or pushed out pins, corrosion, etc. ● Using the special tool, check each of the lead frame connector pins.  A0027061 ● **Does the special tool go through the lead frame connector pins?**	**Yes** INSTALL a new lead frame. GO to D6 . **No** GO to D6 .
D6 CHECK SOLENOID RESISTANCE AT SOLENOID	
● Disconnect: Transmission Harness . ● Measure the resistance between the pins of the solenoid.  AD1399-A ● Measure the resistance of the EPC solenoid. ● **Is the resistance between 2.48 and 5.66 ohms?**	**Yes** GO to D7 . **No** INSTALL a new solenoid. CLEAR the DTCs. REPEAT the OBD Tests.
D7 CHECK SOLENOID FOR SHORT TO GROUND	
● Check for continuity between engine GROUND and the EPC solenoid terminals with ohmmeter or other low current tester (less than 200 milliamps). Connection should show infinite resistance (no continuity).  AD1400-A ● **Is there continuity?**	**Yes** INSTALL a new solenoid. CLEAR the DTCs. REPEAT the OBD Tests. **No** REFER to Diagnosis By Symptom in this section for diagnosis of pressure concerns.

PINPOINT TEST E: OUTPUT SHAFT SPEED (OSS) SENSORS

Test Step	Result / Action to Take
NOTE: Refer to the Output Shaft Speed (OSS) Sensor Harness Connector illustration preceding these pinpoint tests.	
E1 ELECTRONIC DIAGNOSTICS ● Check to make sure the transmission harness connector is fully seated, pins are fully engaged in connector and in good condition before proceeding. ● Connect the diagnostic tool. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Diagnostic Data Link. ● Enter the following diagnostic mode on the diagnostic tool: PCM. ● Select PID/Data Monitor and Record. ● Select the PID OSS. ● **Does vehicle enter PID/Data Monitor and Record?**	**Yes** GO to E2 . **No** REPEAT procedure to ENTER PID. If vehicle did not enter PID, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of PCM.
E2 DRIVE CYCLE TEST ● While monitoring the OSS Speed PID, drive the vehicle so that the transmission upshifts and downshifts through all gears. ● **Does the OSS Speed PID increase and decrease with engine and vehicle speed?**	**Yes** CLEAR all DTCs. ROAD TEST to verify if concern is still present. If concern is still present, REFER to Diagnosis By Symptom in this section. **No** If the OSS Speed PID does not increase and decrease with engine and vehicle speed, INSPECT for open or short in vehicle harness, sensor, a PCM concern, or internal hardware concern. If the sensor signal is erratic, INSPECT for intermittent concern in the internal/external harness, sensor, or connector. If the sensor signal is steady, GO to E3 .
E3 CHECK RESISTANCE OF OSS SENSOR ● Disconnect the vehicle harness connector from the OSS sensor. ● Measure the resistance between the OSS sensor pins.  AD1084-B	**Yes** REFER to Diagnosis By Symptom for concern diagnosis. **No** INSTALL a new OSS sensor.

• Record the resistance. **Sensor** / **Resistance (ohms)** / **Temperature** OSS / 791 to 1,795 / -40°C to 160°C (-40°F to 320°F) • **Is the resistance within specification?**	

PINPOINT TEST F: SOLENOID MECHANICAL FAILURE

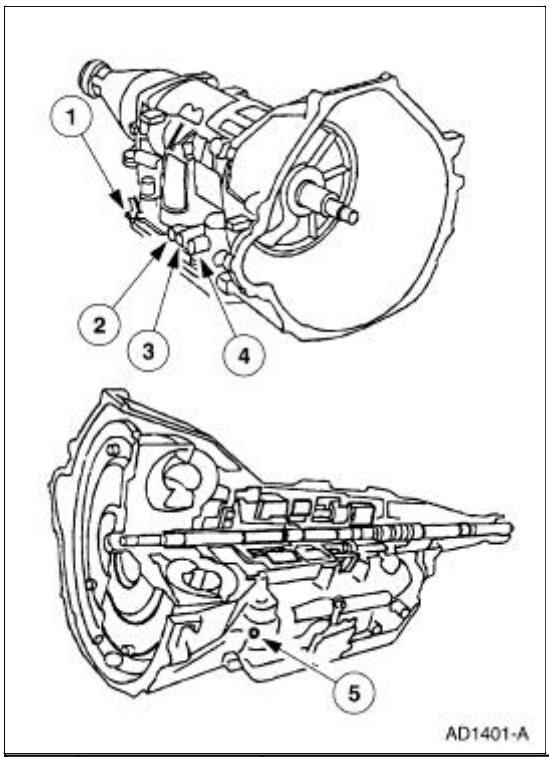
Test Step	Result / Action to Take
NOTE: Repair all other DTCs before repairing the following DTCs: P1714, P1715, P1740.	
F1 ELECTRONIC DIAGNOSIS • Connect the diagnostic tool. • Carry out KOEO test. • **Are only DTCs P1714, P1715, P1740 present?**	**Yes** REPAIR the other DTCs first. CLEAR DTCs and CARRY OUT Transmission Drive Cycle Test. REPEAT Quick Test. **No** INSTALL a new solenoid and or body. REFER to the Diagnostic Trouble Code Charts in this section for code description. GO to F2 .
F2 TRANSMISSION DRIVE CYCLE TEST • Carry out transmission drive cycle test. • Carry out On-Board Diagnostic Test. • **Does the vehicle upshift and downshift OK?**	**Yes** GO to F3 . **No** REFER to Diagnosis By Symptom in this section to diagnose shift concerns.
F3 RETRIEVE DTCS • Connect the diagnostic tool. • Carry out KOEO test until continuous DTCs have been displayed. • **Are DTCs P1714, P1715, P1740 still present?**	**Yes** INSTALL a new PCM. REFER to Section 303-14 . ROAD TEST and REPEAT Quick Test. **No** Testing completed. If a concern still exists, REFER to Diagnosis By Symptom in this section for concern diagnosis.

Special Testing Procedures

The special tests are designed to aid the technician in diagnosing the hydraulic and mechanical portion of the transmission.

Engine Idle Speed Check

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the engine idle speed.



Item	Part Number	Description
1	—	Direct clutch pressure tap
2	—	Forward clutch pressure tap
3	—	Electronic pressure control (EPC) pressure tap
4	—	Intermediate clutch pressure tap
5	—	Line pressure tap

Line Pressure Test

CAUTION: Carry out the line pressure test prior to carrying out the stall speed test. If the line pressure is low at stall, do not carry out stall speed test or further transmission damage will occur. Do not maintain WOT in any transmission range for more than five seconds.

This test verifies that the line pressure is within specification.

1. Connect pressure gauge to line pressure tap.

2. Start engine and check line pressures. Refer to the Line Pressure Chart to determine if line pressure is within specification.

Line Pressure Chart

Application	Range	Idle		WOT Stall	
		EPC	Line Pressure	EPC	Line Pressure
4.6L	P, N, OD, 2, 1	207-276 kPa (30-40 psi)	552-689 kPa (80-100 psi)	689-758 kPa (100-110 psi)	1310-1448 kPa (190-210 psi)
4.6L	R	13-82 kPa (2-12 psi)	441-683 kPa (64-99 psi)	572-655 kPa (83-95 psi)	1427-1855 kPa (207-269 psi)
3.8L	P, N, OD, 2, 1	138-207 kPa (20-30 psi)	448-586 kPa (65-85 psi)	689-758 kPa (100-110 psi)	1310-1448 kPa (190-210 psi)
3.8L	R	103-172 kPa (15-25 psi)	448-620 kPa (65-90 psi)	572-662 kPa (83-96 psi)	1427-1862 kPa (207-270 psi)

Clutch Pressure Chart 3.8L

Transmission Pressures with TP at 1.5 Volts and Vehicle Speed Above 8 Km/h (5 MPH)					
Gear	EPC Tap [a]	Line Pressure Tap	Forward Clutch Tap	Intermediate Clutch Tap	Direct Clutch Tap
M1	172-241 kPa (25-35 psi)	517-655 kPa (75-95 psi)	448-586 kPa (65-85 psi)	0-34 kPa (0-5 psi)	0-34 kPa (0-5 psi)
M2	103-241 kPa (15-25 psi)	413-551 kPa (60-80 psi)	344-482 kPa (50-70 psi)	393-517 kPa (55-75 psi)	0-34 kPa (0-5 psi)
1	172-241 kPa (25-35 psi)	517-655 kPa (75-95 psi)	448-586 kPa (65-85 psi)	0-34 kPa (0-5 psi)	0-34 kPa (0-5 psi)
2	103-241 kPa (15-25 psi)	413-551 kPa (60-80 psi)	358-468 kPa (52-68 psi)	379-517 kPa (55-75 psi)	0-34 kPa (0-5 psi)
3	137-206 kPa (20-30 psi)	413-517 kPa (60-75 psi)	413-517 kPa (60-75 psi)	413-551 kPa (60-80 psi)	379-517 kPa (55-75 psi)
4	172-241 kPa (25-35 psi)	517-655 kPa (75-95 psi)	0-34 kPa (0-5 psi)	482-620 kPa (70-90 psi)	448-586 kPa (65-85 psi)

[a] EPC readings will vary due to EEC strategy. These values are approximate pressures. Actual clutch apply pressures should be within 69-103 kPa (10-15 psi) of line pressure. For additional information on testing, refer to the Clutch Pressure Test in this section.

Clutch Pressure Chart 4.6L

Transmission Pressures with TP at 1.5 Volts and Vehicle Speed Above 8 Km/h (5 MPH)					
Gear	EPC Tap [a]	Line Pressure Tap	Forward Clutch Tap	Intermediate Clutch Tap	Direct Clutch Tap
M1	172-241 kPa (25-35 psi)	517-655 kPa (75-95 psi)	448-586 kPa (65-85 psi)	0-34 kPa (0-5 psi)	0-34 kPa (0-5 psi)
M2	103-241 kPa (15-25 psi)	413-551 kPa (60-80 psi)	344-482 kPa (50-70 psi)	393-517 kPa (55-75 psi)	0-34 kPa (0-5 psi)
1	172-241 kPa	517-655 kPa (75-	448-586 kPa (65-	0-34 kPa (0-5 psi)	0-34 kPa (0-5

	(25-35 psi)	95 psi)	85 psi)		psi)
2	103-241 kPa (15-25 psi)	413-544 kPa (60-79 psi)	344-482 kPa (50-70 psi)	379-517 kPa (55-75 psi)	0-34 kPa (0-5 psi)
3	172-241 kPa (25-35 psi)	517-655 kPa (75-95 psi)	372-579 kPa (54-84 psi)	482-613 kPa (70-89 psi)	379-586 kPa (55-85 psi)
4	241-310 kPa (35-45 psi)	620-758 kPa (90-110 psi)	0-34 kPa (0-5 psi)	586-730 kPa (85-105 psi)	551-689 kPa (80-100 psi)

[a] EPC readings will vary due to EEC strategy. These values are approximate pressures. Actual clutch apply pressures should be within 69-103 kPa (10-15 psi) of line pressure. For additional information on testing, refer to the Clutch Pressure Test in this section.

3. Place the ignition switch in the OFF position. If line pressure is not within specification, check EPC pressure.

4. Connect pressure gauge to EPC pressure tap.

5. Start engine and check EPC pressure. Use the line pressure chart for specifications.

6. If EPC pressure is not within specification, Go To Pinpoint Test E to diagnose EPC operation. If EPC operation is OK, see the line pressure diagnosis chart for line pressure concern causes.

Line Pressure Diagnosis Chart

Test Results	Possible Source
High At Idle — In All Positions	· Wiring Harnesses
	· Run Quick Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	· EPC Solenoid · Main Regulator Valve
Low At Idle — In All Positions	· Low Fluid Level
	· Control Bodies
	· Leakage in Pump
	· Damaged Gaskets on Separator Valve
	· Damaged Separator Plate
	· Restricted Inlet Filter
	· Case Bolts
	· Loose Main Control Valve Body
	· EPC Solenoid O-Ring
	· EPC Solenoid Bracket
	· Case
	· Sticking Main Regulator Valve · Damaged Inlet Tube Seal on Inlet Filter
Low In Park Only	· Valve Body · Low/Reverse Servo
Low In Reverse Only	· Separator Plate
	· Low/Reverse Servo or Valve Bodies

	· Reverse Clutch
Low In Neutral Only	· Valve Body
Low In Overdrive Only	· Forward Clutch · Valve Body
Low In 1st Position Only	· Forward Clutch
	· Valve Body · Low/Reverse Servo
Low In 2nd Only	· Intermediate Clutch
	· Valve Bodies · Forward Clutch

Stall Speed Test

WARNING: Apply the parking brake firmly while carrying out each stall test.

CAUTION: Carry out line pressure test prior to carrying out stall test. If the line pressure is low at stall, do not carry out stall test or further transmission damage will occur.

The stall speed test checks:

- the torque converter clutch operation and installation.
- the holding ability of the forward clutch.
- the reverse clutch (the low-reverse bands).
- the planetary one-way clutch.
- the engine driveability.

Conduct this test with the engine coolant and transmission fluid at correct levels and at normal operating temperature.

Apply the parking brake firmly for each stall speed test.

1. Find the specified stall rpm for the vehicle; see the stall speed diagnosis chart. Use a grease pencil to mark the rpm on the dial of a tachometer.

Stall Speed

Application	Min.	Max.
3.8L engine	2,240	2,619
4.6L 2V engine	2,339	2,738
4.6L 4V MACH 1 engine	2,375	2,767

2. Connect a tachometer to the engine.

3. **NOTE:** If the rpm recorded by the tachometer exceeds the maximum limits, release the accelerator pedal immediately because clutch or band slippage is indicated.

   In each of the following ranges (D), 2, 1, R, press the accelerator pedal to the floor and hold it

just long enough to let the engine get to wide open throttle (WOT). While making this test, do not hold the throttle open for more than 5 seconds at a time.

4. Note the results in each range.

5. After each range, move the shift control selector lever to NEUTRAL and run the engine at 1,000 rpm for about 15 seconds to cool the torque converter before making the next test.

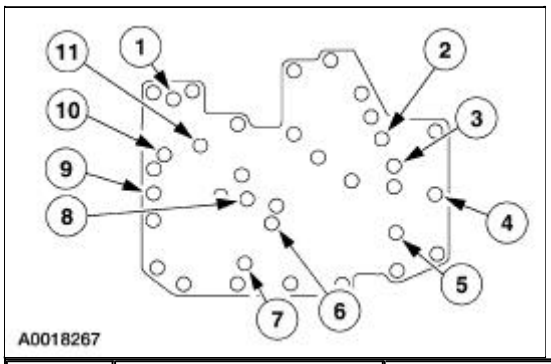
6. Refer to the stall speed diagnosis chart for corrective actions.

Stall Speed Diagnosis Chart

Selector Position	Stall Speeds High	Stall Speeds Low
(D)	Planetary One-Way Clutch	
(D), 2 and 1	Forward Clutch or Intermediate Clutch	
(D), 2, 1 and R	Carry Out Pressure Test	Torque Converter Stator One-Way Clutch or Engine Driveability Concerns
R	Reverse Clutch or Low Reverse Band or Servo	

Air Pressure Tests

Transmission Air Test Plate



Item	Part Number	Description
1	—	Converter bypass
2	—	Direct clutch
3	—	Forward clutch
4	—	2-3 accumulator, top
5	—	2-3 accumulator, bottom
6	—	Reverse servo
7	—	Overdrive servo, apply
8	—	Overdrive servo, release
9	—	Intermediate clutch
10	—	Reverse clutch
11	—	1-2 accumulator, apply

A no-drive condition can exist even with correct transmission fluid pressure because of inoperative clutches or bands. An erratic shift can be located through a series of checks by substituting air pressure for fluid pressure to determine the location of the malfunction.

Follow the procedure to determine the location of the inoperative clutch or band by introducing air pressure into the various test plate passages.

NOTE: Use only dry, regulated 276 kPa (40 psi) maximum air pressure.

Apply air to the appropriate passage(s). A dull thud should be felt or heard or movement could be observed when the clutch component applies. There should be no hissing sound when the component is applied.

Cover the vent hole in the test plate with a clean, lint-free shop towel to prevent spray when the air is applied. Plugging the vent hole during testing will result in inaccurate results.

1. Drain transmission fluid and remove the transmission fluid pan.

2. Remove the main control valve body.

3. Install transmission test plate and gasket. Tighten bolts to 10 Nm (89 lb-in).

4. **NOTE:** Do not apply air to the test plate vent hole.

   Apply air to the appropriate clutch port (refer to the Transmission Air Test Plate illustration). A dull thud may be heard or movement felt when the component is applied or released. If clutch seals or check balls are leaking a hissing sound may be heard.

If the servos do not operate, disassemble, clean and inspect them to locate the source of the concern.

If air pressure applied to the clutch passages fails to operate a clutch, or operates clutches simultaneously, inspect the fluid passages in the case.

If air pressure applied to the accumulator fails to operate an accumulator, remove and inspect case passages and piston.

Clutch Pressure Test

The Clutch Pressure Test will diagnose a low-pressure condition or leakage in a clutch circuit. A difference of 103 kPa (15 psi) or more between the clutch pressure and line pressure will prevent a normal shift.

1. **CAUTION: Pressure gauges affect the shift quality of the transmission. Care must be taken not to accelerate or decelerate rapidly. Possible transmission failure can result.**

   Attach 0-2068 kPa (0-300 psi) pressure gauges to the line pressure tap and the appropriate clutch pressure tap according to Band and Clutch Application Chart A&B. Gauges must be accurate enough to distinguish a 103 kPa (15 psi) difference. (If this test is done in conjunction with a control pressure test, pressure gauges will be attached to all pressure taps.) Have sufficient flexible hose available to read the gauges in the vehicle.

2. Drive the vehicle. When pressure is applied to the clutch, note the difference between the line pressure gauge and the corresponding clutch pressure gauge.

3. If the difference in pressures is less than 103 kPa (15 psi), the corresponding clutch circuit does not have a pressure loss. The gauges on the line pressure tap and appropriate clutch pressure tap can be switched to confirm that gauge calibration differences are not the cause.

4. If the difference is greater than 103 kPa (15 psi), there is a leak in the corresponding clutch pressure circuit. The gauges on the line pressure tap and clutch pressure tap can be switched to confirm that gauge calibration differences are not the cause. Carry out the appropriate procedure to correct the clutch leak problem.

Leakage Inspection

CAUTION: Do not try to stop the fluid leak by increasing the torque beyond specifications. This may cause damage to the case threads.

Check the fluid filler tube connection at the transmission case. If leakage is found here, install a new grommet.

Check the VSS plug or VSS sensor O-ring (model dependent). If leakage is found install a new O-ring.

Check fluid lines and fittings between the transmission and the cooler in the radiator tank for looseness, wear, or damage. If leakage cannot be stopped by tightening a fluid tube nut, install new parts. When fluid is found leaking between the case and cooler line fitting, check for missing or damaged O-ring, then tighten the fitting to maximum specification.

If the leak continues, install a new cooler line fitting and tighten to specification. The same procedure should be followed for fluid leaks between the radiator cooler and the cooler line fittings in this section; refer to Section 307-02 .

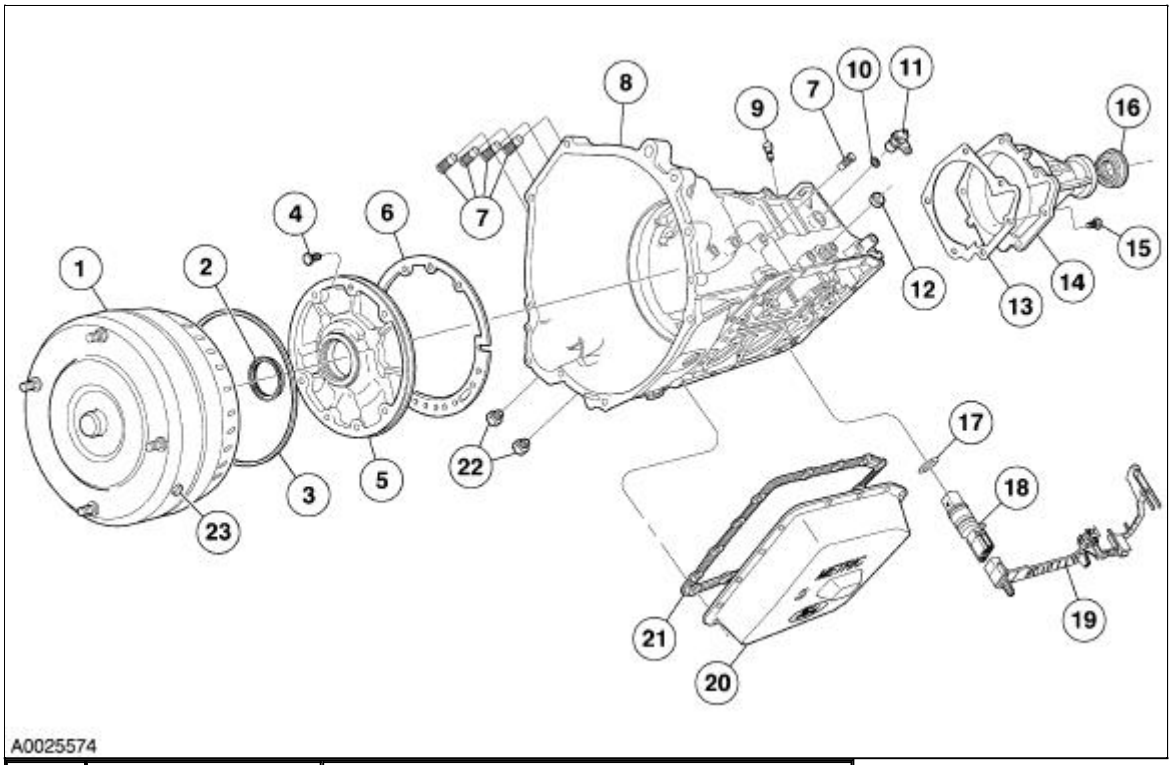
Check the engine coolant in the radiator. If transmission fluid is present in the coolant, the cooler in the radiator is probably leaking.

The cooler can be further checked for leaks by disconnecting the lines for the cooler fittings and applying no more than 345 kPa (50 psi) air pressure to the fittings. Remove the radiator cap to relieve the pressure buildup at the exterior of the oil cooler tank. If the cooler is leaking and or will not hold pressure, install a new cooler.

If leakage is found at the transmission range selector lever, install a new seal.

If leakage is found at the transmission internal harness connector, install a new O-ring.

4R70W External Sealing

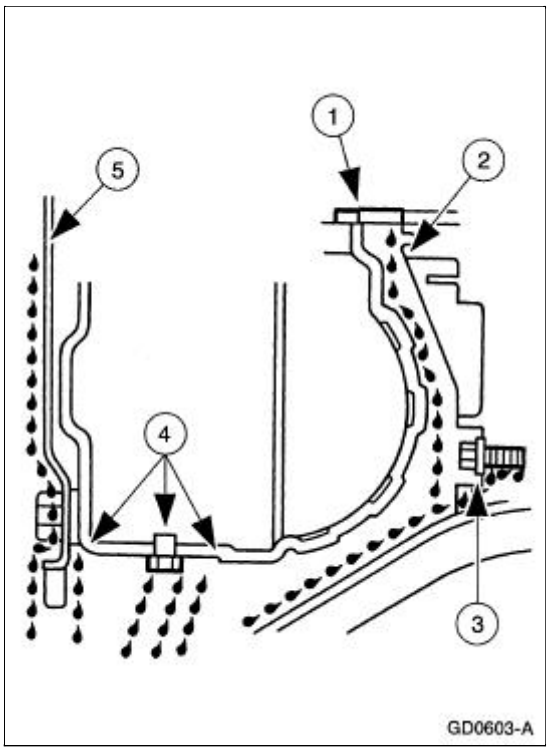


Item	Part Number	Description
1	7902	Torque converter
2	7A248	Front pump seal
3	7A248	Front pump seal
4	N605789-S101	Bolt
5	7A106	Front pump body assembly
6	7A136	Pump gasket
7	390318-S2	Pipe plug — 1/8 — 27 Dryseal tapered
8	7005	Case
9	7034	Vent
10	N811757-S100	Speed sensor seal
11	7H103	Output shaft speed (OSS) sensor
12	7B498	Manual control lever seal assembly
13	7086	Extension housing gasket
14	7A039	Extension housing
15	N803737-S1101	Bolt — M8-1.25 x 30
15	N606047-S101	Bolt — M8-1.25 x 70
15	N803521-S1101	Bolt — M8-1.25 x 1.25 x 0.54
15	N811524-S101	Bolt — M8-1.25 x 42
16	7052	Oil seal
17	7Z276	Seal — bulkhead assembly
18	7G276	Bulkhead assembly wiring connector
19	7G276	Molded lead frame
20	7A194	Transmission fluid pan
21	7A191	Gasket

22	7D273	Fluid tube connector
23	87650-S2	Converter drain plug

Fluid Leakage in Torque Converter Area

In diagnosing and correcting fluid leaks in the front pump support and gear and torque converter area, use the following procedures to locate the exact cause of the leakage. Leakage at the front of transmission, as evidenced by fluid around the torque converter housing, may have several sources. By careful observation it is possible, in many instances, to pinpoint the source of leak before removing the transmission from the vehicle. The paths which the fluid takes to reach the bottom of the torque converter housing are shown in the illustration. The five steps following correspond with the numbers in the illustration.



1. Fluid leaking by the front pump seal lip will tend to move along the impeller hub and onto the back of the impeller housing. Except in the case of a total seal failure, fluid leakage by the lip of the seal will be deposited on the inside of the torque converter housing only, near the outside diameter of the housing.

2. Fluid leakage by the outside diameter of the front pump seal and front pump body will follow the same path that leaks by the inside diameter of the front pump seal follow.

3. Fluid that leaks by a front pump to case bolt or pump gasket will be deposited on the inside of the torque converter housing only. Fluid will not be deposited on the back of the torque converter.

4. Fluid leakage from the converter drain plug, (model dependent) converter seal weld or converter to flexplate stud weld will appear at the outside diameter of the torque converter on the back face of the flexplate and in the converter housing only near the flexplate. Fluid leaks from the torque converter will leave a ring of fluid around the inside of the torque converter housing.

5. **NOTE:** White facial tissue paper may aid in determining the color (red is transmission fluid) and source of the leaking fluid.

   Engine oil leaks are sometimes incorrectly diagnosed as transmission pump gasket leaks. The

following areas of possible leakage should also be checked to determine if engine oil leakage is causing the concern.

a. Leakage at the engine valve cover gasket may allow oil to flow over the torque converter housing or seep down between the torque converter housing and cylinder block causing oil to be present in or at the bottom of the torque converter housing.
b. Oil galley plug leaks will allow oil to flow down the rear face of the cylinder block to the bottom of the torque converter housing.
c. Leakage at the crankshaft rear oil seal will work back to the flexplate, and then into the torque converter housing.
d. Leakage at engine oil pressure sensor.

Leak Check Test

1. Remove the fluid level indicator and note the color of the fluid. Original factory fill fluid is dyed red to aid in determining if leakage is from the engine or transmission. Unless a considerable amount of makeup fluid has been added or the fluid has been changed, the red color should assist in pinpointing the leak.

2. Remove the torque converter housing cover. Clean off any fluid from the top and bottom of the torque converter housing, front of the case and rear face of the engine and oil pan. Clean the torque converter area by washing with a suitable nonflammable solvent and blow dry with compressed air.

3. Wash out the torque converter housing, the front of the flexplate and the converter drain plugs. The torque converter housing may be washed out using cleaning solvent and a squirt-type oil can. Blow all washed areas dry with compressed air.

4. Start and run the engine until the transmission reaches its normal operating temperature. Observe the back of the cylinder block and top of the torque converter housing for evidence of fluid leakage. Raise the vehicle on a hoist; refer to Section 100-02 and run the engine at fast idle, then at engine idle, occasionally shifting to the Overdrive and Reverse ranges to increase pressure within the transmission. Observe the front of the flexplate, back of the cylinder block (in as far as possible), and inside the torque converter housing and front of the case. Run the engine until fluid leakage is evident and the probable source of leakage can be determined.

Leak Check Test With Black Light Used With 12 Volt Master UV Diagnostic Inspection Kit

Oil soluble aniline or fluorescent dyes premixed at the rate of 2.5ml (1/2 teaspoon) of dye powder to 0.235L (1/2 pint) of transmission fluid have proved helpful in locating the source of fluid leakage. Such dyes may be used to determine whether an engine oil or transmission fluid leak is present, or if the fluid in the fluid cooler leaks into the engine cooling system. A black light must be used with the fluorescent dye solution.

Transmission Fluid Cooler

CAUTION: Whenever a transmission has been disassembled to install new parts, the cooler bypass valve (CBV), all transmission fluid coolers (in tank and auxiliary) and transmission fluid cooler lines must be cleaned and backflushed. Use a suitable the torque converter/fluid cooler cleaner.

NOTE: Cleaning and backflushing the transmission fluid cooling system along with following all the normal cleaning and inspection procedures in this section during disassembly and reassembly will keep contamination from reentering the transmission and causing a repeat repair.

When internal wear or damage has occurred in the transmission, metal particles, clutch plate material, or band material may have been carried into the torque converter and transmission fluid cooler. These contaminants are a major cause of recurring transmission troubles and must be removed from the system before the transmission is put back into use.

Transmission Fluid Cooler Flow Test

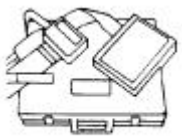
NOTE: The transmission linkage/cable adjustment, fluid level and line pressure must be within specification before carrying out this test. Refer to Section 307-05 for adjustments.

1. Remove fluid level indicator from fluid filler tube.
2. Place funnel in fluid filler tube.
3. Position the vehicle on a hoist. For additional information, refer to Section 100-02 .
4. Remove the cooler return line (top fitting) from the fitting on the transmission case.
5. Connect one end of a hose to the cooler return line and route other end of the hose up to a point where it can be inserted into the funnel at the fluid filler tube.
6. Remove the safety stands and lower the vehicle. Insert end of hose into the funnel.
7. Start the engine and run it at idle with the transmission in NEUTRAL.
8. When fluid flows from the hose in a steady stream, a liberal amount of fluid should be observed. "Liberal" is about 1 liter (1 quart) delivered in 15 seconds. If a liberal flow is observed, the test is complete.
9. If the flow is not liberal, stop the engine. Disconnect the hose from the cooler return line and connect it to the converter outlet fitting (bottom fitting) on the transmission case.
10. Repeat steps 6 and 7. If flow is now approximately 1 liter (1 quart) in 15 seconds, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section. If the flow is still not approximately 1 liter (1 quart) in 15 seconds, repair or install pump and or converter.

For the installation of new transmission fluid cooler or tubes, refer to Section 307-02 .

Diagnosis By Symptom

Special Tool(s)

ST1565-A	Transmission Fluid Pressure Gauge 307-004 (T57L-77820-A)
ST1392-A	Air Test Plate, Transmission 307-246 (T92P-7006-A)
 ST1391-A	Breakout Box, EEC-V Control System 418-049 (T94L-50-EEC-V) or equivalent
ST1632-A	MLP-TR Cable 418-F107 (007-00111) or equivalent
ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052 or equivalent scan tool
ST1389-A	Transmission Tester 307-F016 (007-00130) or equivalent
	Trans Tester TR/MLP Overlay and Manual 007-00131 or equivalent
	73 III Automotive Meter

ST1137-A	105-R0057 or equivalent
ST1300-A	UV Leak Detector Kit 164-R0756 or equivalent

The Diagnosis by Symptom charts give the technician diagnostic information, direction, and suggest possible components, using a symptom as a starting point.

The Diagnosis by Symptom charts are divided into two categories: Electrical Routines, indicated by 200 series numbers, and Hydraulic/Mechanical Routines, indicated by 300 series numbers. The Electrical Routines list the possible electrical components that could cause or contribute to the symptom described. The Hydraulic/Mechanical Routines list the possible hydraulic or mechanical components that could cause or contribute to the symptom described.

Diagnosis by Symptom Chart Directions

1. Using the Diagnosis by Symptom Index, select the Concern/Symptom that best describes the condition.

2. Refer to the routine indicated in the Diagnosis by Symptom Index.

3. Always begin diagnosis of a symptom with:

a. preliminary inspections.
b. verifications of condition.
c. checking the fluid levels.
d. carrying out other test procedures as directed.

4. **NOTE:** Not all concerns and conditions with electrical components will set a diagnostic trouble code (DTC). Be aware that the components listed may still be the cause. Verify correct function of these components prior to proceeding to the Hydraulic/Mechanical Routine listed.

   Begin with the Electrical Routine, if indicated. Follow the reference or action required statements. Always carry out the on-board diagnostic tests as required. Never skip steps. Repair as required. If the concern is still present after electrical diagnosis, then proceed to the Hydraulic/Mechanical Routine listed.

5. The Hydraulic/Mechanical Routines list possible hydraulic or mechanical components that could cause the concern. These components are listed in the removal sequence and by most probable cause. All components listed must be inspected to ensure correct repair.

Diagnosis by Symptom Index

Title	Routines	
	Electrical [a]	Hydraulic/ Mechanical

Engagement Concerns		
No Forward	201	301
No REVERSE	202	302
Harsh REVERSE	203	303
Harsh Forward	204	304
Delayed/Soft Reverse	205	305
Delayed/Soft Forward	206	306
Shift Concerns		
Some/All Shifts Missing	210	310
Timing Concerns		
—Early/Late	211	311
—Erratic/Hunting	212	312
Feel		
—Soft/Slipping	213	313
—Harsh	214	314
No 1st Gear, Engages in Higher Gear	215	315
No Manual 1st Gear	216	316
No Manual 2nd Gear	217	317
Torque Converter Operation Concerns		
No Apply	240	340
Always Applied/Stalls Vehicle	241	341
Cycling/Shudder/Chatter	242	342
Other Concerns		
No Engine Braking in 2nd Gear, Manual 2nd or Manual 1st Position	250	350
Gearshift Lever Efforts High	251	351
External Leaks	252	352
Vehicle Driveability Concerns	253	353
Noise/Vibration in Forward or Reverse	254	354
Engine Will Not Crank	255	355
No PARK (P) Range	256	356
Overheating	257	357

[a] Carry out electrical routine first.

Diagnostic Routines

Engagement Concern: No Forward

Possible Component	Reference/Action
201 — ELECTRICAL ROUTINE	
· No Electrical Concerns	
301 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect as under Fluid Condition Check; refer to Verification of

	Condition.
Shift Linkage	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify the digital transmission range (TR) sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Low forward clutch pressure, low line pressure	· Check pressure at line and forward clutch tap. Refer to Line Pressure Chart for specification. If pressures are low, check the following components: oil filter and seal assembly, main controls, pump assembly, forward clutch assembly.
Fluid Filter and Seal Assembly	
· Plugged, damaged	· Install a new filter and seal assembly.
· Filter seal damaged	
Main Controls	
· 3-4 shift valve, main regulator valve, manual valve — stuck, damaged	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Gaskets damaged	· Inspect gaskets for damage and install a new gasket.
· 2-3 accumulator and seals damaged	· Inspect piston, seals and bore for damage. Repair as required.
· Pressure regulator valve	· Inspect the diameter for wear.
Pump Assembly	
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Porosity/cross leaks/ball missing or leaking, plugged hole	· Inspect for porosity and leaks. Repair as required.
· No. 3 and No. 4 seal rings damaged	· Inspect seals for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Forward Clutch Assembly	
· Seals, piston damaged	· Inspect seals for damage. Repair as required.
· Check balls damaged, missing, mislocated, not seating correctly	· Inspect for mislocation, poor seating, damage. Install a new cylinder as required.
· Friction elements damaged or worn	· Check for abnormal wear, damage. Repair as required.
One-Way Clutch Assembly (Planetary)	
· Worn, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
Output Shaft	

· Damaged	· Inspect for damage. Install new components as required.

Engagement Concern: No Reverse

Possible Component	Reference/Action
202 — ELECTRICAL ROUTINE	
· No Electrical Concerns	
302 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Shift Linkage	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Low reverse clutch pressure, low reverse band pressure, low line pressure	· Check pressure at line pressure tap; refer to Line Pressure Chart for specifications. If pressures are low, check the following components: oil filter and seal assembly, main controls, reverse servo, pump assembly, reverse clutch assembly.
Fluid Filter and Seal Assembly	
· Plugged, damaged	· Install a new filter and seal assembly.
Main Controls	
· No. 6 shuttle ball, manual valve, main regulator valve, 1-2 accumulator seals stuck or damaged	· Inspect for damage. Repair as required.
· Loose bolts	· Tighten bolts to specifications.
· Gasket damaged	· Inspect for damage and install a new gasket.
Low/Reverse Servo	
· Seals (piston and cover) damaged	· Inspect for damage. Repair as required.
· Servo cover retaining ring damaged	
· Anchor pins (case) damaged	
Pump Assembly	
· Loose bolts	· Tighten bolts to specifications.
· Porosity/cross leaks/ball missing or leaking, plugged hole	· Inspect pump assembly. Install new as required.
· Gasket damaged	· Inspect for damage and install a new gasket.
· No. 1 and 2 seal rings damaged	· Inspect for damage. Repair as required.
Reverse Clutch Assembly	

· Seals, piston damaged	· Inspect for damage. Repair as required.
· Check ball missing or damaged	
· Friction elements damaged or worn	
Low/Reverse Band	· Inspect for damage. Repair as required.
· Band, servo, anchor pins damaged or worn	

Engagement Concern: Harsh Reverse

Possible Component	Reference/Action
203 — ELECTRICAL ROUTINE	
Powertrain Control System	· Carry out Self-Test; refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Carry out engagement test, EPC test and Go To Pinpoint Test B or Go To Pinpoint Test D . Check idle speed. Repair as required. Clear DTCs, road test and repeat Self-Test.
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, TFT sensor, EPC solenoid	
303 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Engine Driveline	· Repair as required.
· Looseness in the driveshaft, U-joints or the engine mounts	
Shift Linkage	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
· Damaged or incorrectly adjusted	
Incorrect Pressures	· Check pressure at line and EPC pressure taps; refer to Line Pressure Chart for specifications. If high, check the following components: main controls, oil filter and seal assembly.
· High line pressure, high EPC pressure	
Fluid Filter and Seal Assembly	
· Plugged or damaged	· Install a new filter and seal assembly.
· Filter seal damaged	
Main Controls	
· No. 6 shuttle ball, No. 5 check ball, manual valve, main regulator valve stuck, damaged or missing	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.

· Gasket damaged	· Inspect for damage and install a new gasket.
· EPC solenoid stuck or damaged	· Inspect for damage, contamination. Carry out EPC test in Routine No. 203. Repair as required.
Low Reverse Servo	
· Seals (piston and cover) damaged	· Inspect for damage. Repair as required.
· Servo cover retaining ring assembled incorrectly	
· Anchor pins (case) damaged	
Pump Assembly	
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Porosity/cross leaks	· Inspect pump assembly. Install new as required.
· Gasket damaged	· Inspect for damage and install a new gasket.
· No. 1 and No. 2 seal rings damaged	· Inspect for damage. Repair as required.
Reverse Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as required.
· Check ball missing or damaged	
· Friction elements damaged, worn	
· Return spring piston damaged, worn	
Low Reverse Band	
· Band, servo, anchor pin damaged or worn	· Inspect for damage. Repair as required.

Engagement Concern: Harsh Forward

Possible Component	Reference/Action
204 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, TFT sensor, EPC solenoid	· Carry out Self-Test; refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Carry out engagement test and EPC test. Go To Pinpoint Test B or Go To Pinpoint Test D . Check idle speed. Repair as required. Clear DTCs, road test and repeat Self-Test.
304 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Engine Driveline	
· Looseness in the driveshaft, U-joints or	· Repair as required.

the engine mounts	
Incorrect Pressures	
· High forward clutch pressure, high line pressure, high EPC pressure	· Check pressure at line, EPC and forward pressure taps. Refer to Line Pressure Chart for specifications. If pressures are high, check the following possible components: main controls, pump assembly.
Main Controls	
· Main regulator valve stuck, damaged	· Inspect and repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Gaskets damaged	· Inspect for damage and install a new gasket.
· EPC solenoid stuck or damaged	· Inspect for damage or contamination. Carry out EPC test in Routine 204. Repair as required.
Case	
· 2-3 accumulator seal/retainer stuck, damaged	· Inspect for damage. Repair as required.
Pump Assembly	
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Porosity/cross leaks	· Inspect for porosity/leaks. Install a new pump as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Forward Clutch Assembly	
· Check balls missing or damaged	· Inspect for mislocation, poor seating, damage. Install a new forward clutch cylinder.
· Friction element damaged or worn	· Inspect for damage. Repair as required.
· Forward clutch wave spring damaged	· Inspect for damage. Repair as required.
· Forward clutch return spring damaged	· Inspect for damage. Repair as required.

Engagement Concern: Delayed/Soft Reverse

Possible Component	Reference/Action
205 — ELECTRICAL ROUTINE	
	· No Electrical Concerns
305 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Shift Linkage	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor

	as necessary.
Incorrect Pressures	
· Low reverse clutch pressure, low reverse band pressure, low line pressure	· Check pressure at line tap; refer to Line Pressure Chart for specifications. If pressures are low, check the following components: main controls, pump assembly, reverse clutch assembly, reverse servo.
Fluid Filter and Seal Assembly	
· Plugged, damaged	· Install a new filter and seal assembly.
	· Filter seal damaged
Main Controls	
· No. 6 shuttle ball, manual valve, main regulator valve stuck or damaged	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Case	
· 1-2 accumulator seals stuck or damaged	· Inspect for damage. Repair as required.
Low Reverse Servo	
· Seals (piston and cover) damaged	· Inspect for damage. Repair as required.
· Servo cover retaining ring assembled incorrectly	
Pump Assembly	
· Bolts not tightened to specification	· Tighten bolts to specification.
· Porosity/cross leaks/ball missing or leaking	· Inspect pump assembly. Install new as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
· No. 1 and No. 2 seal rings damaged	· Inspect for damage. Repair as required.
Reverse Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Install new components as required.
· Check ball missing or damaged	
· Friction elements damaged, worn	
· Return spring and piston damaged, worn	
Low Reverse Band	
· Damaged, worn	· Inspect for damage. Repair as required.

Engagement Concern: Delayed/Soft Forward

Possible Component	Reference/Action
206 — ELECTRICAL ROUTINE	
	· No Electrical Concerns
306 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Shift Linkage	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Low forward clutch pressure, low line pressure, low EPC pressure	· Check pressure at line, forward clutch and EPC taps; refer to Line Pressure Chart for specifications. If pressures are low, check the following components: oil filter and seal assembly, main controls and pump assembly.
Fluid Filter and Seal Assembly	
· Plugged, damaged	· Install a new filter and seal assembly.
· Filter seal damaged	
Main Controls	
· 3-4 shift valve, main regulator valve stuck or damaged	· Inspect and repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Gaskets damaged	· Inspect for damage and repair as required.
Case	
· 2-3 or 1-2 accumulator, bore damaged or stuck	· Inspect for damage. Repair as required.
Pump Assembly	
· Bolts not tightened to specification	· Tighten bolts to specifications.
· Porosity/cross leaks	· Inspect pump assembly. Repair as required.
· Gaskets damaged	· Inspect for damage. Repair as required.
· No. 3 and No. 4 seal rings damaged	· Inspect for damage. Repair as required.
Forward Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as required.
· Check balls missing, damaged	· Inspect for mislocation, poor seating, damage. Install a new cylinder as required.
· Friction elements damaged, worn	· Check for damage. Repair as required.

Shift Concerns: Some/All Shifts Missing

Possible Component	Reference/Action
210 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, output shaft speed (OSS) sensor, digital TR sensor	· Carry out Self-Test; refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A , Go To Pinpoint Test C or Go To Pinpoint Test E . Repair as required. Clear DTCs, road test and repeat Self-Test.
310 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Shift Linkage, Digital TR Sensor	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
	· Refer to the following shift routine(s) for further diagnosis: ■ Shift 1-2, Routine 220/320 ■ Shift 2-3, Routine 221/321 ■ Shift 3-4, Routine 222/322 ■ Shift 4-3, Routine 223/323 ■ Shift 3-2, Routine 224/324 ■ Shift 2-1, Routine 225/325

Shift Concerns: Timing Concerns — Early/Late

Possible Component	Reference/Action
211 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, EPC solenoid, TFT sensor, OSS	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A , Go To Pinpoint Test C or Go To Pinpoint Test E . Repair as required. Clear DTCs, road test and repeat Self-Test.
311 — HYDRAULIC/MECHANICAL ROUTINE	
Other	
· Tire size change, axle ratio change	· Verify vehicle has original equipment. Refer to Certification Label and Safety Standard Certification Label. Changes in tire size or axle ratio will affect shift timing.
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Powertrain Control System	
· Engine driveability concerns	· Refer to Routine 253.

Incorrect Pressures	
· Line pressure, EPC pressure	· Check pressure at line and EPC taps; refer to Line Pressure Chart for specifications. If not OK, check the main controls. If OK, refer to the shift routine(s) for further diagnosis: ■ Shift 1-2, Routine 320 ■ Shift 2-3, Routine 321 ■ Shift 3-4, Routine 322 ■ Shift 4-3, Routine 323 ■ Shift 3-2, Routine 324 ■ Shift 2-1, Routine 325
Main Controls	
· EPC solenoid, stuck or damaged hydraulically or mechanically	· Inspect for damage, contamination. Carry out EPC tests in Routine No. 211. Repair as required.
· Valves, accumulators, seals stuck or damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
· Solenoid screen blocked or damaged	· Clean or install a new screen.

Shift Concerns: Timing Concerns — Erratic/Hunting

Possible Component	Reference/Action
212 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, torque converter clutch (TCC) solenoid, digital TR sensor, output shaft speed (OSS)	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Go To Pinpoint Test A , Go To Pinpoint Test C or Go To Pinpoint Test E . Repair as required. Clear DTCs, road test and repeat Self-Test.
· Poor engine performance	· Refer to Routine 253.
312 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Main Controls	
· Valves, accumulators, seals, assembled wrong, stuck or damaged	· Inspect for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
· Solenoid screen blocked or damaged	· Clean or install a new screen.
Torque Converter Clutch	
· Torque converter	· Refer to Torque Converter Operation Concerns: Cycling/Shudder/Chatter Hydraulic/Mechanical Routine 342.
Specific Shifts	
	· Refer to the following shift routine(s) for further diagnosis:

	■ Shift 1-2, Routine 320 ■ Shift 2-3, Routine 321 ■ Shift 3-4, Routine 322 ■ Shift 4-3, Routine 323 ■ Shift 3-2, Routine 324 ■ Shift 2-1, Routine 325

Shift Concerns: Feel — Soft/Slipping

Possible Component	Reference/Action
213 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, EPC solenoid, OSS	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test D or Go To Pinpoint Test E . Repair as required. Clear DTCs, road test and repeat Self-Test.
· Engine driveability concerns	· Refer to Routine 253.
313 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Incorrect Pressures	
· Low line pressure, low EPC pressure	· Check pressures at line and EPC taps; refer to Line Pressure Chart for specifications. If pressures are low or all shifts are soft/slipping, go to main controls. If pressures are OK and a specific shift is soft/slipping, refer to the following routine(s) for further diagnosis: ■ Shift 1-2, Routine 320 ■ Shift 2-3, Routine 321 ■ Shift 3-4, Routine 322 ■ Shift 4-3, Routine 323 ■ Shift 3-2, Routine 324 ■ Shift 2-1, Routine 325
Main Controls	
· Main regulator valve, overdrive servo regulator valve stuck, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· EPC solenoid stuck or damaged	· Inspect for damage and contamination. Carry out EPC tests in Routine 213. Repair as required.
Case	
· 1-2 accumulator stuck or damaged	· Inspect for damage. Repair as required.
Filter and Seal Assembly	
· Filter plugged, damaged	· Inspect for damage. Install a new filter as required.
· Seal damaged or cut	· Inspect for damage. Replace as required.

Shift Concerns: Feel — Harsh

Possible Component	Reference/Action
214 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, EPC solenoid, OSS	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test D or Go To Pinpoint Test E . Repair as required. Clear DTCs, road test and repeat Self-Test.
· Engine driveability concerns	· Refer to Routine 253.
314 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Incorrect Pressures	
· High line pressure, high EPC pressure	· Check pressures at line and EPC taps. See the to Line Pressure Chart for specifications. If pressures are high or all shifts are harsh, go to Main Controls. If pressures are OK and a specific shift is harsh, refer to the following shift routine(s) for further diagnosis: ■ Shift 1-2, Routine 320 ■ Shift 2-3, Routine 321 ■ Shift 3-4, Routine 322 ■ Shift 4-3, Routine 323 ■ Shift 3-2, Routine 324 ■ Shift 2-1, Routine 325
Main Controls	
· Main regulator valve, overdrive servo regulator valve stuck, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· EPC solenoid stuck or damaged	· Inspect for damage or contamination. Carry out EPC tests in Routine 214. Repair as required.

Shift Concerns: No 1st Gear, Engages In Higher Gear

Possible Component	Reference/Action
215 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, digital transmission range TR sensor	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A or Go To Pinpoint Test C . Repair as required. Clear DTCs, road test and repeat Self-Test.
315 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Digital TR Sensor	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment. Refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted.

	Adjust the digital TR sensor as necessary.
Incorrect Pressures	
・Low reverse clutch pressure, low reverse band pressure, low line pressure ● Forward Off, Intermediate Off, Direct X ● Forward Off, Intermediate X, Direct Off ● Forward Off, Intermediate X, Direct X ● Forward X, Intermediate Off, Direct X ● Forward X, Intermediate X, Direct Off ● Forward X, Intermediate X, Direct X ● Forward X, Intermediate Off, Direct Off	・Check for which pressures are on and refer to Band/Clutch Application Chart 601 and corresponding routines. ■ 324, 301 ■ 325, 301 ■ 323, 324, 325, 301 ■ 324 ■ 325 ■ 323, 324, 325 ■ Refer to appropriate mechanical diagnosis.
Mechanical	
・Bands, clutches or seals damaged or worn	・Refer to Transmission Disassembly and Assembly.

X = pressure applied

Shift Concerns: No Manual 1st Gear

Possible Component	Reference/Action
216 — ELECTRICAL ROUTINE	
Powertrain Control System	
・Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, digital TR sensor	・Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A or Go To Pinpoint Test C . Repair as required. Clear DTCs, road test and repeat Self-Test.
316 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Cable, Digital TR Sensor	
・Damaged or incorrectly adjusted	・Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
・Low reverse clutch pressure, low reverse band pressure, low line pressure, low EPC pressure	・Check pressure at line and EPC pressure taps; refer to Line Pressure Chart for specifications. If pressures are low, check the following components: oil filter and seal assembly, main controls, reverse clutch assembly and reverse servo assembly.
Fluid Filter and Seal Assembly	
・Plugged or damaged	・Install a new filter and seal assembly.

Main Controls	
· No. 6 shuttle ball, manual valve, main regulator valve, low servo modulator valve stuck, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Low Reverse Servo	
· Seals (piston and cover) damaged	· Inspect for damage. Repair as required.
	· Servo cover retaining ring assembled incorrectly.
	· Anchor pins (case) damaged.

Shift Concerns: No Manual 2nd Gear

Possible Component	Reference/Action
217 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, digital TR sensor	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A or Go To Pinpoint Test C . Repair as required. Clear DTCs, road test and repeat Self-Test.
317 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Cable, Digital TR Sensor	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Main Controls	
· 3-4 shift valve, 1-2 and 2-3 shift valve, 3-4 capacity modulator valve stuck, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Gaskets damaged	· Inspect for damage and install a new gasket.

Shift Concerns: 1-2 Shift (Automatic)

Possible Component	Reference/Action
220 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs,	· Carry out Self-Test. Refer to the Powertrain Control/Emissions

vehicle wiring harnesses, PCM, shift solenoids, OSS	Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A or Go To Pinpoint Test E . Repair as required. Clear DTCs, road test and repeat Self-Test.
· Poor engine performance	· Refer to Routine 253.
320 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Digital TR Sensor	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Intermediate clutch pressure, line pressure	· Check pressure at line and intermediate clutch taps; see the line pressure chart for specifications. If not OK, check the main controls.
Main Controls	
· 1-2 shift valve, stuck or damaged	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specification.
· Shift solenoid SSA malfunction	· Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
· Gasket damaged	· Inspect for damage and install a new gasket.
· No. 8 ball not seating	· Inspect for damage. Repair as required.
Case	
· 1-2 accumulator stuck or damaged	· Inspect for damage. Repair as required.
Pump	
· Porosity/cross leaks, balls missing, damaged or leaking	· Inspect for porosity/leaks, balls missing. Install a new pump as required.
· Gasket damaged	· Inspect for damage and install a new gasket.
Intermediate Clutch Assembly	
· Seals damaged	· Inspect for damage. Repair as required.
· Piston damaged	· Inspect for damage. Repair as required.
· Friction elements damaged or worn	· Inspect for damage. Repair as required.
Intermediate One-Way Clutch Assembly	
· Not holding or damaged	· Inspect for damage. Repair as required.
Planetary One-Way Clutch Assembly	
· Not overrunning or damaged	· Inspect for damage. Repair as required.
1-2 Accumulator	
· Damaged accumulator	· Inspect for damage. Repair as required.

piston	
· Springs damaged or broken	· Inspect for damage. Repair as required.
· Case bore scored	· Inspect for damage. Repair as required.

Shift Concerns: 2-3 Shift (Automatic)

Possible Component	Reference/Action
221 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, OSS	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A or Go To Pinpoint Test E . Repair as required. Clear DTCs, road test and repeat Self-Test.
· Engine driveability concerns	· Refer to Routine 253.
321 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment. Refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Direct clutch pressure	· Check pressure at direct clutch tap; refer to Line Pressure Chart for specifications. If not OK, check the main controls.
Main Controls	
· 2-3 shift valve, check ball No. 9 or No. 3, solenoid pressure regulator valve, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Shift solenoid SSB malfunction	· Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
· Output shaft seals damaged or cup plug leaking or missing	· Inspect for damage and repair as required.
· 2-3 accumulator damaged or stuck	· Inspect piston seal and bore for damage. Repair as required.
· Solenoid screen (in main control) blocked or damaged	· Clean or install a new screen.
Intermediate One-Way Clutch Assembly	
· Not overrunning or damaged	· Inspect for damage. Repair as required.
Output Shaft	
· Seal rings damaged	· Inspect for damage. Repair as required.
· Cup plug damaged or missing	

Direct Clutch Assembly	
· Seals or piston damaged	· Inspect for damage. Repair as required.
· Friction elements worn or damaged	· Inspect for damage. Repair as required.
· Check ball not seating	· Inspect for damage. Repair as required.
· Return spring assembly damaged	· Inspect for damage. Repair as required.
Case	
· Output shaft rear seals leaking or damaged	· Inspect for damage. Repair as required. Inspect case for damaged seal area. If damaged, install a new case.
2-3 Accumulator	
· Damaged accumulator piston	· Inspect for damage. Repair as required.
· Springs damaged or broken	· Inspect for damage. Repair as required.
· Case bore scored	· Inspect for damage. Repair as required.

Shift Concerns: 3-4 Shift (Automatic)

Possible Component	Reference/Action
222 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, OSS, transmission control switch (TCS)	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A or Go To Pinpoint Test E . Repair as required. Clear DTCs, road test and repeat Self-Test.
· Engine driveability concerns	· Refer to Routine 253.
322 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Digital TR Sensor	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Forward clutch pressure, direct clutch pressure, line pressure	· Check line, direct and forward clutch pressures at appropriate taps; refer to Line Pressure Chart for specifications. If pressures are out of specification, check main controls.
Main Controls	
· 3-4 shift valve, solenoid pressure regulator valve, OD servo regulator, 3-4 capacity modulator valve, 1-2 and 2-3 shift valves stuck, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· SSA or SSB malfunction	· Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as

	required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
· OD servo rod and piston cushion spring or seals damaged	· Inspect for damage. Repair as required.
· Worn or damaged OD servo anchor pins	· Inspect for damage. Repair as required.
· No. 2, No. 4, No. 7 and No. 9 check balls damaged or missing	· Inspect for damage. Repair as required.
· Solenoid screen blocked or damaged	· Clean or install a new screen.
Pump	
· Porosity/cross leaks, balls missing, damaged or leaking	· Inspect for porosity/leaks, balls missing. Install a new pump as required.
· Gaskets damaged	· Inspect for damage. Install new gaskets as required.
OD Band	
· OD band and reverse clutch drum assembly damaged, worn or assembled incorrectly	· Inspect for damage. Repair as required.
· Intermediate one-way clutch assembly damaged	· Inspect for damage. Repair as required.
Forward Clutch Assembly	
· Seals or piston damaged	· Inspect for damage. Repair as required.
· Friction elements worn or damaged	· Inspect for damage. Repair as required.
· Check ball stuck, damaged or not seating correctly	· Inspect for damage. Repair as required.
Input Shaft	
· Seals damaged	· Inspect for damage. Repair as required.

Shift Concerns: 4-3 Shift (Automatic)

Possible Component	Reference/Action
223 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, transmission control switch (TCS)	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A . Repair as required. Clear DTCs, road test and repeat Self-Test.
323 — HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· Forward clutch pressure, line pressure	· Check line and forward clutch at pressure taps; refer to Line Pressure Chart for specifications. If out of specification, check the main controls.
Main Controls	
· 3-4 shift valve, solenoid pressure regulator valve, OD servo regulator, 3-4 capacity modulator, 1-2 and 2-3 shift valves stuck, damaged or assembled	· Inspect for damage. Repair as required.

incorrectly	
· Check balls No. 2, No. 7, No. 9 damaged, missing or not seating correctly	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specification.
· SSA malfunction	· Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
· OD servo, seal, rod damaged	· Inspect for damage. Repair as required.
· Solenoid screen blocked or damaged	· Clean or install a new screen.
Pump	
· Porosity/cross leaks, balls missing, damaged or leaking	· Inspect for porosity/leaks, balls missing. Install a new pump as required.
· Seal rings damaged	· Inspect for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Overdrive Band	
· OD band and reverse clutch assembly damaged, worn or assembled incorrectly	· Inspect for damage. Repair as required.
· Intermediate one-way clutch assembly damaged	· Inspect for damage. Repair as required.
Forward Clutch Assembly	
· Seals or piston damaged	· Inspect for damage. Repair as required.
· Friction elements damaged, worn	· Inspect for damage. Repair as required.
· Check ball stuck, damaged or not seating correctly	· Inspect for damage. Repair as required.
· Forward clutch piston and return spring damaged	· Inspect for damage. Repair as required.
Input Shaft	
· Seals damaged	· Inspect for damage. Repair as required.

Shift Concerns: 3-2 Shift (Automatic)

Possible Component	Reference/Action
224 — ELECTRICAL ROUTINE	
Powertrain Control System	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A . Repair as required. Clear DTCs, road test and repeat Self-Test.
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids	
324 — HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	· Check pressure at direct clutch tap; refer to Line Pressure Chart for specifications. If not within specification, check the main controls.
· Direct clutch	
Main Controls	

· 2-3 shift valve stuck or damaged	· Inspect for damage. Repair as required.
· Check balls damaged or missing	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· SSB malfunction	· Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Intermediate One-Way Clutch	
· Not holding or damaged	· Inspect for damage. Repair as required.
· Intermediate one-way retaining clutch snap ring not seated	· Inspect for damage. Repair as required.
Direct Clutch Assembly	
· Seals or piston damaged	· Inspect for damage. Repair as required.
· Friction element damaged, worn	· Inspect for damage. Repair as required.
· Check ball stuck, damaged or not seating correctly	· Inspect for damage. Repair as required.

Shift Concerns: 2-1 Shift (Automatic)

Possible Component	Reference/Action
225 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A . Repair as required. Clear DTCs, road test and repeat Self-Test.
325 — HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· Intermediate clutch	· Check pressure at intermediate clutch tap; refer to Line Pressure Chart for specifications. If not within specifications, check main controls and pump.
Main Controls	
· 1-2 shift valve, 1-2 accumulator solenoid pressure regulator valve stuck, damaged or assembled wrong	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· SSA malfunction	· Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage; repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.

Pump	
· Gaskets damaged	· Inspect for damage and install a new gasket.
· Porosity/cross leaks	· Inspect for leak/porosity. Install a new pump as required.
Intermediate Clutch Assembly	
· Piston damaged	· Inspect for damage. Repair as required.
· Friction elements damaged, worn	· Inspect for damage. Repair as required.
· End clearance incorrect	· Inspect and correct; refer to Transmission Assembly.
Intermediate One-Way Clutch	
· Damaged	· Inspect for damage. Repair as required.
· Intermediate one-way clutch retaining snap ring not seated	· Inspect for damage. Repair as required.
Planetary One-Way Clutch	
· Not holding or damaged	· Inspect for damage. Repair as required.

Torque Converter Clutch Operation Concerns: No Apply

Possible Component	Reference/Action
240 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, torque converter clutch (TCC) solenoid, TFT sensor, OSS	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test B or Go To Pinpoint Test E . Repair as required. Clear codes, road test and repeat Self-Test.
340 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Low line pressure, low EPC pressure	· Check pressure at line and EPC taps; refer to Line Pressure Chart for specifications. If pressure is low, check EPC and main regulator valve. If within specifications, check the main controls.
Main Controls	
· Solenoid pressure regulator valve, manual valve, bypass clutch control valve and plunger, converter pressure limit valve, drain back valve stuck, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Solenoid screen blocked or damaged	· Clean or install a new screen.
· TCC solenoid malfunction	· Activate solenoid using scan tool. If solenoid operation

	cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Pump Assembly	
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Porosity/cross leaks, balls leaking	· Inspect for porosity/leaks, ball missing. Install a new pump as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Input Shaft	
· Seals damaged	· Inspect for damage. Repair as necessary.
Torque Converter Assembly	
· Leakage, friction material damaged, internal seals damaged	· Inspect torque converter. Repair or install a new or remanufactured torque converter as required.

Torque Converter Clutch Operation Concerns: Always Applied/Stalls Vehicle

Possible Component	Reference/Action
241 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, torque converter clutch (TCC) solenoid, TFT sensor	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test B or Go To Pinpoint Test A . Repair as required. Clear DTCs, road test and repeat Self-Test.
341 — HYDRAULIC/MECHANICAL ROUTINE	
Main Control	
· Drain back valve, torque converter clutch (TCC) and plunger stuck, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· TCC solenoid malfunction	· Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
· No. 7 ball incorrect seating	· Inspect for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Pump Assembly	
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Ball missing, leaking, porosity/cross leaks	· Inspect for porosity/leaks, balls missing. Install a new pump as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Input Shaft	
· Seals damaged	· Inspect for damage. Repair as required.
Torque Converter Assembly	

· No end clearance	· Inspect converter and install a new or remanufactured torque converter as required.
· Piston plate damaged or stuck to cover	· If cover is heat-stained, install a new converter and determine the cause of the overheat condition.

Torque Converter Clutch Operation Concerns: Cycling/Shudder/Chatter

Possible Component	Reference/Action
242 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, torque converter clutch (TCC) solenoid, OSS	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test E . Repair as required. Clear DTCs, road test and repeat Self-Test.
· Speed control equipped vehicles	· Evaluate with speed control off.
342 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Condition	· Inspect fluid condition. If burnt, drain fluid and converter. Install a new fluid and filter assembly. Bring vehicle to normal operating temperature. Carry out Transmission Drive Cycle Test. Carry out Transmission Self-Test. If condition still exists, continue diagnostics.
Main Controls	
· Solenoid pressure regulator valve, No. 7 check ball, bypass clutch control valve and plunger, converter pressure limit valve stuck, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Solenoid screen blocked or damaged	· Clean or install a new screen.
· TCC solenoid malfunction	· Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Pump Assembly	
· Bolts not tightened to specification	· Tighten bolts to specification.
· Porosity/cross leaks, missing balls or leaking	· Inspect for porosity/leaks or missing balls. Install a new pump as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Input Shaft	
· Seals damaged	· Inspect for damage. Repair as required.
Torque Converter	
· Excessive end clearance	· Inspect converter. Install a new or re-manufactured torque converter as required.

Other Concerns: No Engine Braking In Manual 2nd Or Manual 1st Position

Possible Component	Reference/Action
250 — ELECTRICAL ROUTINE	
	· No Electrical Concerns
350 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Main Controls	
· 3-4 shift valve, 1-2 and 2-3 shift valve, gaskets, 3-4 capacity modulator valve, stuck or damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· OD servo assembly damaged or stuck in manual 2nd only.	· Inspect cover, piston and seal for damage. Repair as required.
· Low/Reverse servo assembly damaged or stuck in manual 1st only	· Inspect cover, piston and seal for damage. Repair as required.
Overdrive	
· Reverse band, manual 1st (only) damaged	· Inspect for damage. Repair as required.
· OD band, reverse clutch drum assembly worn or damaged (manual 2nd only)	· Inspect for damage. Repair as required.
Reverse Band (Manual 1st Only)	
· Damaged or incorrectly adjusted	· Inspect for damage. Repair as required.

Other Concerns: Shift Lever Efforts High

Possible Component	Reference/Action
251 — ELECTRICAL ROUTINE	
	· No Electrical Concerns
351 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Digital TR Sensor	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
· Brake shift interlock system, solenoid damaged	· Refer to the appropriate brake section in the workshop manual.
Manual Lever	
· Retaining pin damaged, nut loose, detent spring bent or damaged or Park	· Inspect for damage. Repair as required.

mechanism damaged	
Main Controls	
· Manual valve stuck or damaged	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.

Other Concerns: External Leaks

Possible Component	Reference/Action
252 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, sensor seals leaking (digital TR, OSS, vehicle speed sensor VSS, if equipped, or transmission connector)	· Inspect for leakage and repair as required.
352 — HYDRAULIC/MECHANICAL ROUTINE	
Case	
· Case vent, case porosity, case cracked	· Check the vent for free breathing. Check the fluid level. Check the transmission for overheat conditions. Repair as required.
Seals/Gaskets	
· Leakage at gaskets, seals, etc. (refer to external sealing illustration for potential leak locations)	· Remove all traces of lubricant on exposed surfaces of the transmission. Check the vent for free breathing. Operate the transmission at normal temperatures and perform fluid leakage check. Repair as required.
Other	
· Cooler fitting, cooler lines pressure tap, converter drain plug, band anchor pins	· Locate the source of the leak. Repair as required.

Other Concerns: Poor Vehicle Performance

Possible Component	Reference/Action
253 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, shift solenoids, digital TR sensor, torque converter clutch (TCC) solenoid, transmission fluid temperature (TFT) sensor	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A , Go To Pinpoint Test B or Go To Pinpoint Test C . Repair as required. Clear codes, road test and repeat Self-Test. Also refer to Routines 241/341 Torque Converter Operation Concern: Always Applied.
· Engine driveability concerns	· Inspect air intake/air filter system. Check the fuel system and fuel pressure. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Inspect the exhaust system for restriction. Refer to Section 309-00 .
353 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Digital TR Sensor	

· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Verify Correct Shift Scheduling and Engagements	
· See Reference/Action	· Go to the appropriate diagnostic routines.
Torque Converter Clutch Always Applied	
· See Reference/Action	· Go to Hydraulic/Mechanical Routine 241/341.
Torque Converter Clutch	
· Damaged	· Inspect torque converter. Install a new converter as outlined.

Other Concerns: Noise/Vibration — Forward Or Reverse

Possible Component	Reference/Action
254 — ELECTRICAL ROUTINE	
	· No Electrical Concerns
354 — HYDRAULIC/MECHANICAL ROUTINE	
For Noises/Vibrations That Change With Engine Speed	
· Converter components/balance weight	· Locate source of disturbance. Repair as required.
· Fluid level (low) pump cavitation	
· Pump assembly	
· Engine drive accessories	
· Cooler lines grounding out	
· Flexplate	
For Noises/Vibrations That Change With Vehicle Speed	
· Engine mounts loose or damaged	· Locate source of disturbance and repair as required.
· Driveline concerns: ■ U-joints ■ Rear axle ■ Suspension ■ Modifications 1st Gear: ■ Low one-way clutch ■ Gearset ■ Friction elements	· Refer to the following shift routine(s) for further diagnosis: ■ Shift 1-2, Routine 320 ■ Shift 2-3, Routine 321 ■ Shift 3-4, Routine 322 ■ Shift 4-3, Routine 323 ■ Shift 3-2, Routine 324 ■ Shift 2-1, Routine 325 ■ Torque Converter Cycling 242/342
· 2nd Gear: ■ Intermediate one-way clutch ■ Intermediate clutch piston bleed hole out of	

12 o'clock position ■ Friction elements	
· 3rd Gear: ■ Torque converter ■ Case to planet support spring ■ Friction elements	
· 4th Gear: ■ Gear set ■ Friction elements ■ Torque converter	
· Reverse: ■ Gear set ■ Friction elements	
· Output shaft splines worn or damaged	
Other Noises/Vibrations	
· Main controls, valve resonance	· Locate source of disturbance and repair as required.
· Shift cable: ■ Vibration ■ Grounding ■ Cooler lines ■ Grounding	

Other Concerns: Engine Will Not Crank

Possible Component	Reference/Action
255 — ELECTRICAL ROUTINE	
Powertrain Control System	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test C . Repair and adjust as required.
· Electrical inputs/outputs, vehicle wiring harnesses, engine starting system hardware, digital TR sensor	
355 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Digital TR Sensor	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
· Damaged or incorrectly adjusted	

Other Concerns: No Park (P) Range

Possible Component	Reference/Action
256 — ELECTRICAL ROUTINE	
· No Electrical Concerns	
356 — HYDRAULIC/MECHANICAL ROUTINE	

Shift Linkage, Digital TR Sensor	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Park Mechanism	
· Output shaft ring, parking brake pawl, parking pawl return spring, park rod guide cup, parking pawl shaft, parking pawl actuating rod, manual lever detent spring damaged or assembled incorrectly	· Inspect for damage or incorrect assembly and repair as required.

Other Concerns: Overheating

Possible Component	Reference/Action
257 — ELECTRICAL ROUTINE	
Refer to Routine 240/340, Torque Converter Operation Concern: No Apply	
357 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Other	
· Damaged, blocked or reversed cooler lines or restriction in the transmission oil cooler	· Inspect for damage and correct installation. Repair as required.
Vehicle Concerns Causing Engine Overheating	
	· Refer to the appropriate engine cooling section.
Main Controls	
· Drain back valve, torque clutch control valve, converter limit valve stuck, damaged or assembled incorrectly	· Inspect for damage and repair as required.
Torque Converter Clutch	
· No apply	· Refer to Routine 240/340.

Transmission Fluid Cooler — Backflushing and Cleaning

1. **CAUTION: Do not use any supplemental transmission fluid additives or cleaning agents. The use of these products could cause internal transmission components to fail; this will effect the operation of the transmission.**

   Conduct backflushing with a suitable torque converter/fluid cooler cleaner. Test your equipment to make sure that a vigorous fluid flow is present before proceeding. Install a new filter in the flush equipment if flow is weak or contaminated.

2. To aid in attaching the cleaner to the transmission steel cooler lines, connect two additional rubber hoses to the transmission end of the steel transmission cooler lines as described below.
   - Connect the cleaner tank pressure line to the steel transmission cooler return line (longest line).
   - Connect a tank return hose to the steel transmission cooler pressure line (shorter line). Place the outlet end of this hose in the solvent tank reservoir.

3. Turn on solvent pump and allow the solvent to circulate a minimum of 5 minutes (cycling switch on and off will help dislodge contaminants in cooler system).

4. Switch off the solvent pump and disconnect the solvent pressure hose from the transmission cooler return line.

5. Use compressed air to blow out the cooler(s) and lines (blow air into the transmission cooler return line) until all solvent is removed.

6. Remove the rubber return hose from the remaining steel cooler line.

Transmission Fluid Drain and Refill

Special Tool(s)

ST2654-A	Automatic Transmission Flush and Fill Machine 211-00018 Automatic Transmission Flush and Fill Machine 199-00010 or equivalent

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM	MERCON®V

Draining

CAUTION: Always refer to the instructions supplied with the flush and fill machine.

NOTE: Draining fluid from the transmission by removing only the fluid pan is acceptable for vehicles that do not have a torque converter drain plug, for normal or severe duty fluid maintenance.

NOTE: A new procedure for draining and adding transmission fluid using a suitable transmission flush and fill machine has been added. The following procedure has different methods for draining and refilling the listed vehicles:

- All vehicles using a suitable flush and fill machine.
- Vehicles equipped with a torque converter drain plug.
- Vehicles without a torque converter drain plug.

Use the method that is applicable to your vehicle.

All vehicles using a suitable flush and fill machine

1. With the vehicle in NEUTRAL, position on a hoist. For additional information, refer to Section 100-02 .
2. Use a suitable flush and fill machine to change the fluid.
3. When connecting the flush and fill machine, connect the machine to the fluid cooler tube after the fluid cooler on the cooler return line. This will help remove any foreign material trapped in the fluid coolers.

Refill

4. Use only clean automatic transmission fluid.

5. Once the fluid exchange has been completed, disconnect the flush and fill machine. Reconnect any disconnected fluid cooler tubes.

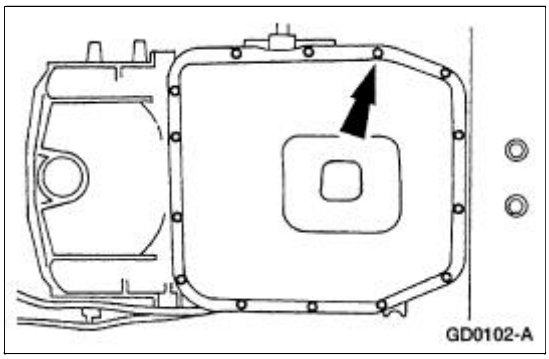
6. With the engine running and the transmission at normal operating temperature 66-77°C (150-170°F), check and adjust the transmission fluid level, and check for any leaks. If fluid is needed, add fluid in increments of 0.24-liter (0.5-pint) until the correct level is achieved (fluid should be in the cross-hatched area of the fluid level indicator).

Draining

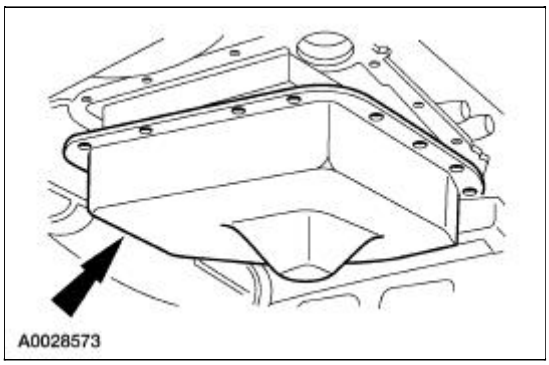
Vehicles equipped with a torque converter drain plug

1. With the vehicle in NEUTRAL, position on a hoist. For additional information, refer to Section 100-02 .

2. Loosen the transmission fluid pan bolts and allow the fluid to drain.

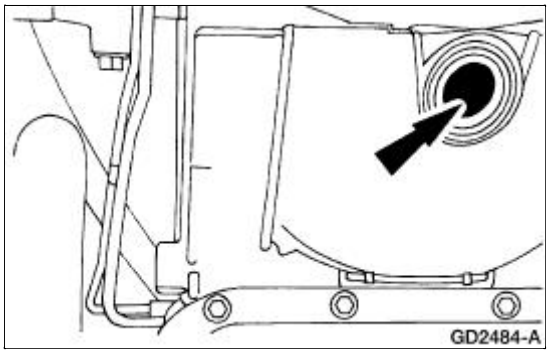


3. After the fluid has drained, remove the transmission fluid pan.

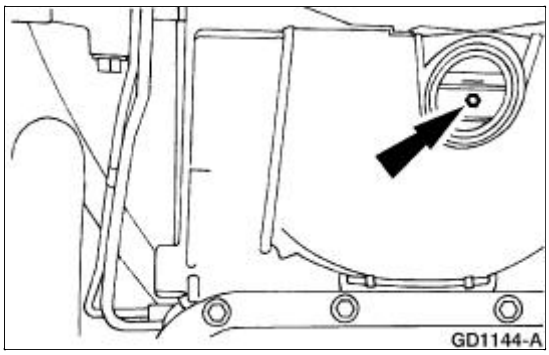


4. Do not remove the fluid filter. It is not necessary to change the fluid filter during a normal maintenance fluid change.

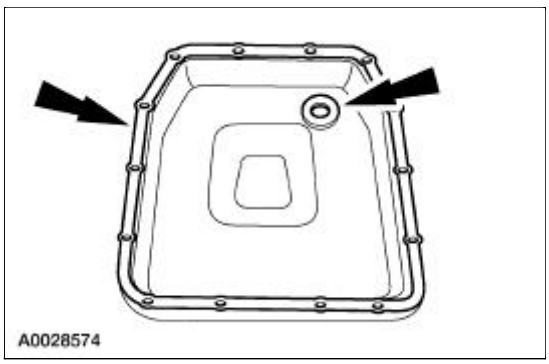
5. Remove the torque converter drain plug cover.



6. Remove the torque converter drain plug and discard.



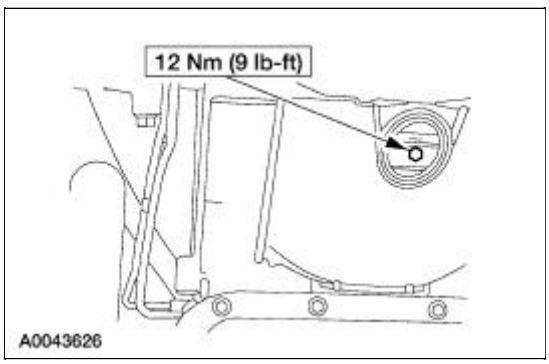
7. Clean and inspect the transmission fluid pan, transmission fluid pan gasket and magnet.



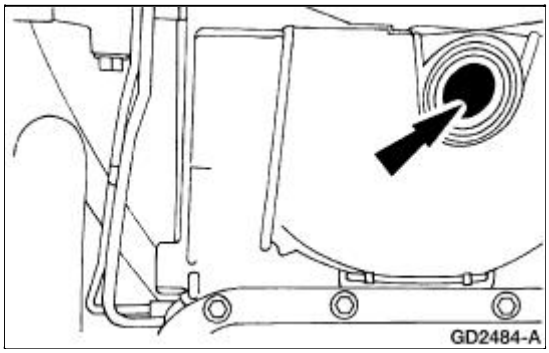
8. Thoroughly flush the cooler tubes. For additional information, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.

Refill

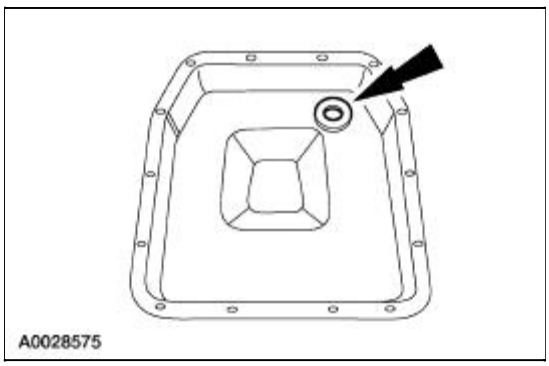
9. After the torque converter has drained, install a new drain plug.



10. Install the torque converter drain plug cover.

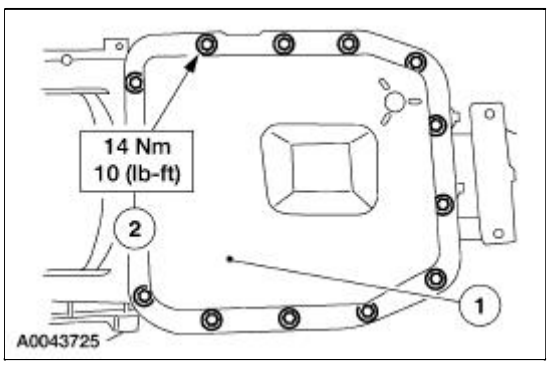


11. Position the magnet into the transmission fluid pan.



12. **NOTE:** The fluid pan gasket is reusable, clean and inspect for damage. If not damaged, the gasket should be reused.

    Install the fluid pan and gasket.
    1. Position the fluid pan with the gasket in place.
    2. Install the bolts.



13. **CAUTION: The use of any other transmission fluid can result in the transmission failing to operate in a normal manner or transmission failure.**

    Fill the transmission.
    - Add 4.7 liters (5 qts) of clean automatic transmission fluid to the transmission through the fluid filler tube.

14. Start the engine. Move the transmission range selector lever through all the gear ranges, checking for engagements.

15. With the engine running and the transmission at normal operating temperature 66-77°C (150-

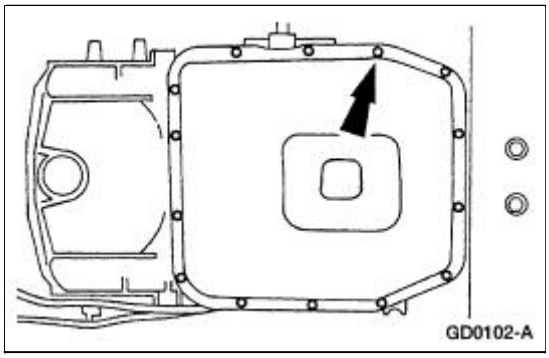
170°F), check and adjust the transmission fluid level, and check for any leaks. If fluid is needed, add fluid in increments of 0.24-liter (0.5-pint) until the correct level is achieved (fluid should be in the cross-hatched area of the fluid level indicator).

Draining

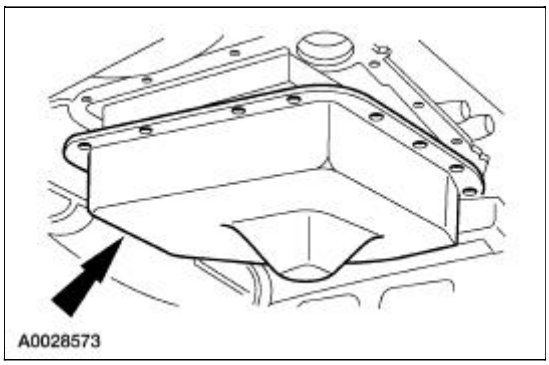
Vehicles without a torque converter drain plug

1. With the vehicle in NEUTRAL, position on a hoist. For additional information, refer to Section 100-02 .

2. Loosen the transmission fluid pan bolts and allow the fluid to drain.

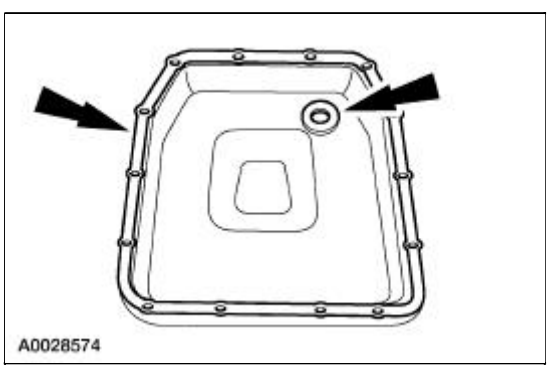


3. After the fluid has drained, remove the transmission fluid pan.



4. Do not remove the fluid filter. It is not necessary to change the fluid filter during a normal maintenance fluid change.

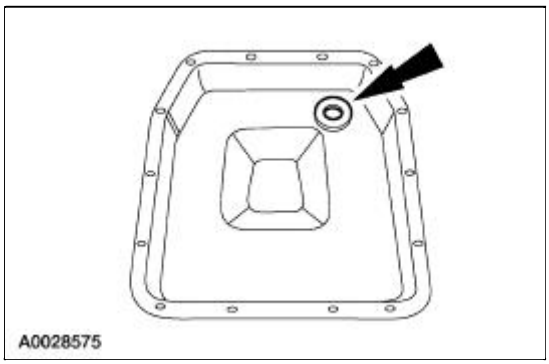
5. Clean and inspect the transmission fluid pan, transmission fluid pan gasket and magnet.



6. Thoroughly flush the cooler tubes. For additional information, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.

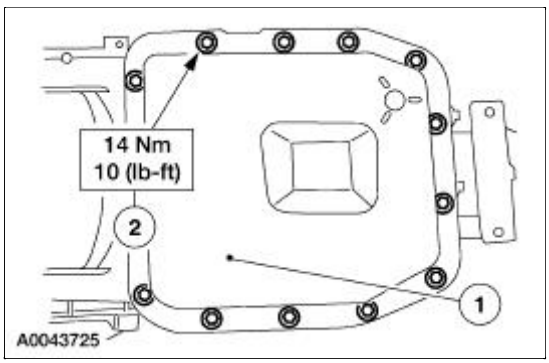
Refill

7. Position the magnet into the transmission fluid pan.



8. **NOTE:** The fluid pan gasket is reusable, clean and inspect for damage. If not damaged, the gasket should be reused.

   Install the fluid pan and gasket.
   1. Position the fluid pan with the gasket in place.
   2. Install the bolts.



9. **CAUTION: The use of any other transmission fluid can result in the transmission failing to operate in a normal manner or transmission failure.**

   Fill the transmission.
   - Add 4.7 liters (5 qts) of clean automatic transmission fluid to the transmission through the fluid filler tube.

10. Start the engine. Move the transmission range selector lever through all the gear ranges, checking for engagements.

11. With the engine running and the transmission at normal operating temperature 66-77°C (150-170°F), check and adjust the transmission fluid level, and check for any leaks. If fluid is needed, add fluid in increments of 0.24-liter (0.5-pint) until the correct level is achieved (fluid should be in the cross-hatched area of the fluid level indicator).

Fluid Pan, Gasket and Filter

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

1. Normal maintenance requires periodic automatic transmission fluid changes. If a major repair, such as a clutch, band, bearing, etc., is required, the automatic transmission will also have to be removed for repair. At this time, the torque converter, transmission cooler and tubes must be thoroughly flushed to remove any dirt. The transmission fluid needs to be changed if evidence of fluid contamination is found. When used under continuous or severe conditions, the transmission and torque converter should be drained and refilled with fluid as specified.

2. **CAUTION: Do not use any supplemental transmission fluid additives or cleaning agents. The use of these products could cause internal transmission components to fail; this will effect the operation of the transmission.**

   CAUTION: Use of a fluid other than specified could result in transmission failure.

   Refer to the vehicle certification label affixed to the LH front door lock face panel or door pillar for the transmission code.

3. When filling a dry transmission and torque converter, refer to General Specifications chart in this section for capacity. Check the fluid level.

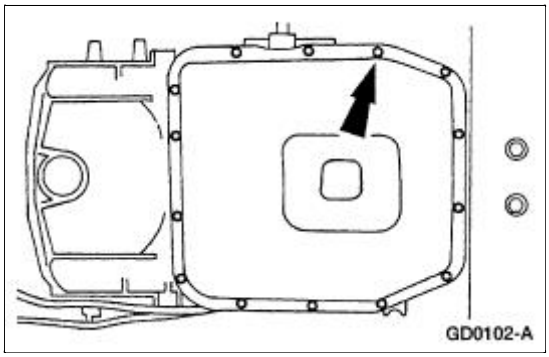
Removal

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

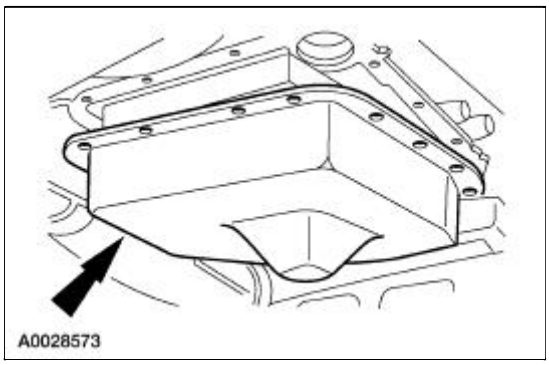
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .

3. Place a drain pan under the transmission fluid pan.

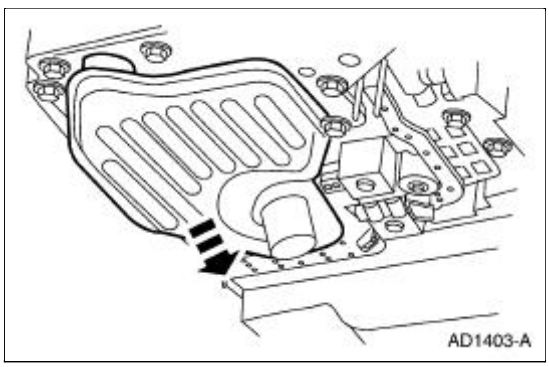
4. Drain transmission fluid.
   - Loosen the transmission fluid pan bolts and allow fluid to drain. After fluid is drained remove the bolts.



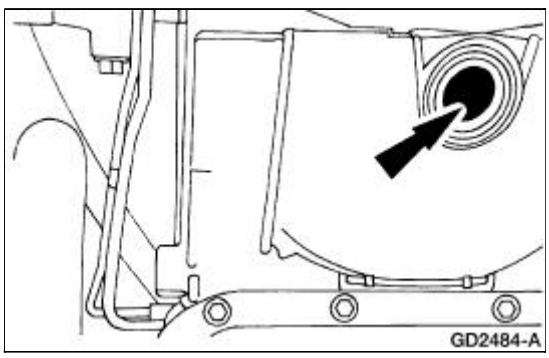
5. Remove the transmission fluid pan and transmission fluid pan gasket.



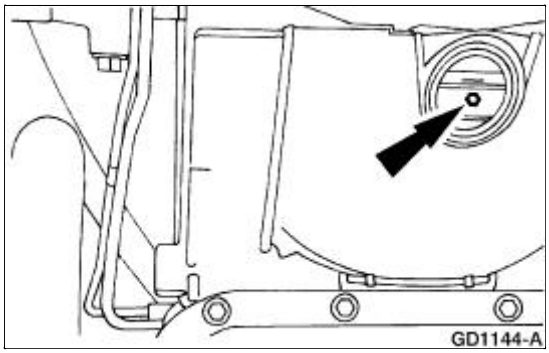
6. Pull down evenly and remove the transmission fluid filter and seal.



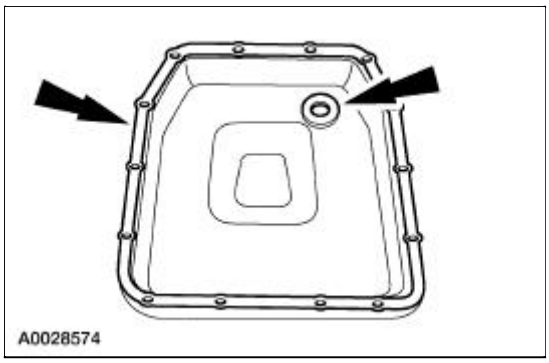
7. Remove torque converter housing plug.



8. Remove the torque converter drain plug and drain the torque converter.
    - Rotate the crankshaft to access the drain plug.



9. Clean and inspect the transmission fluid pan, gasket and magnet.

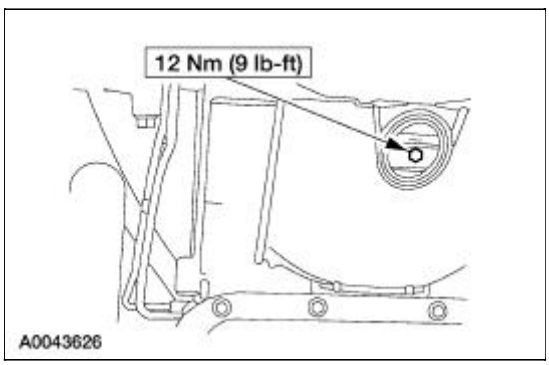


10. Flush the fluid cooler tubes. For additional information, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.

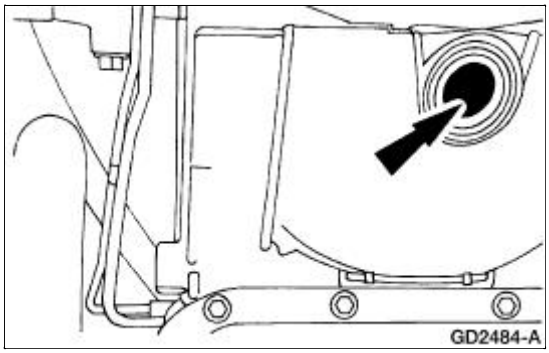
Installation

1. **NOTE:** A new torque converter drain plug must be used.

   Install the torque converter drain plug.



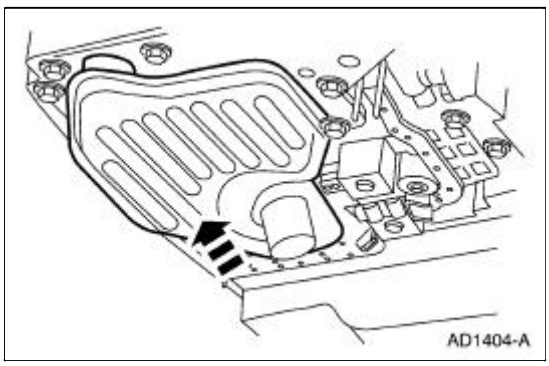
2. Install the torque converter housing plug.



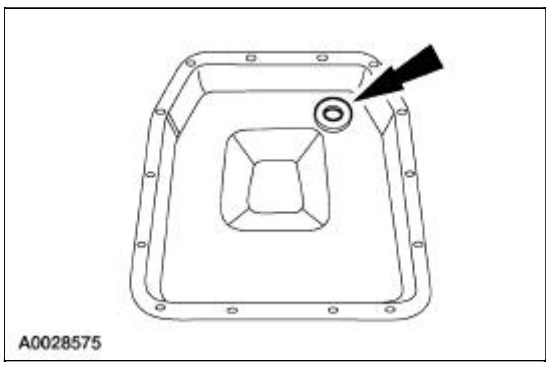
3. **CAUTION: If installing a new filter, and the seal remains in the main control bore, carefully use a small screwdriver to remove the seal. Use care not to damage the main control bore.**

   NOTE: If transmission is being repaired for a contamination-related failure, use a new filter and seal. The filter may be reused if no excessive contamination is present.

   Install a new fluid filter and seal as required.

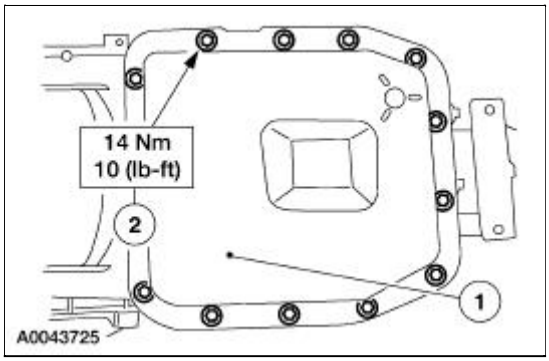


4. Position the pan magnet into the transmission fluid pan.



5. **NOTE:** The transmission fluid pan gasket is reusable. Clean and inspect for damage; if not damaged, the gasket should be reused.

   Install the transmission fluid pan and gasket.
   1. Position the transmission fluid pan and gasket.
   2. Install the transmission fluid pan bolts.



6. Lower the vehicle.

7. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.

   Connect the battery ground cable. For additional information, refer to Section 414-01 .

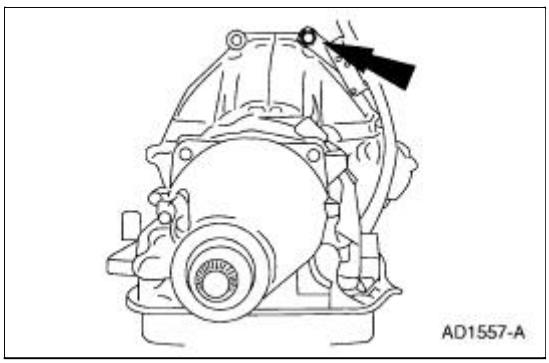
8. **NOTE:** When filling a dry transmission and converter, start with a minimum of 4.7 liters (5 quarts).

   Fill the transmission to the correct level with clean automatic transmission fluid.

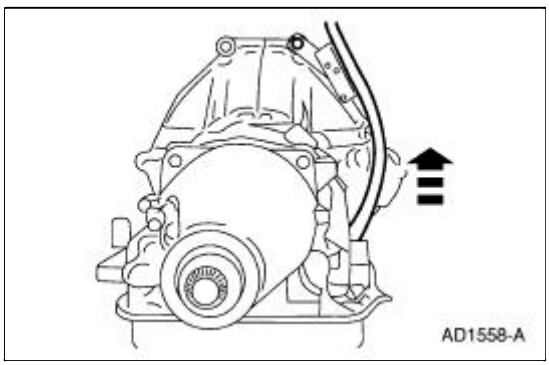
Transmission Filler Tube

Removal

1. Remove the bolt.

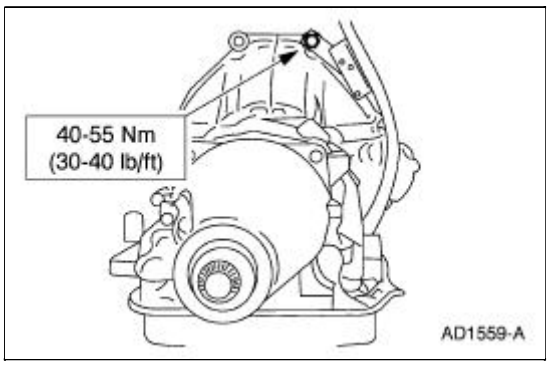


2. Remove the fluid filler tube.



Installation

1. To install, reverse the removal procedure.



Main Control Valve Body

Special Tool(s)

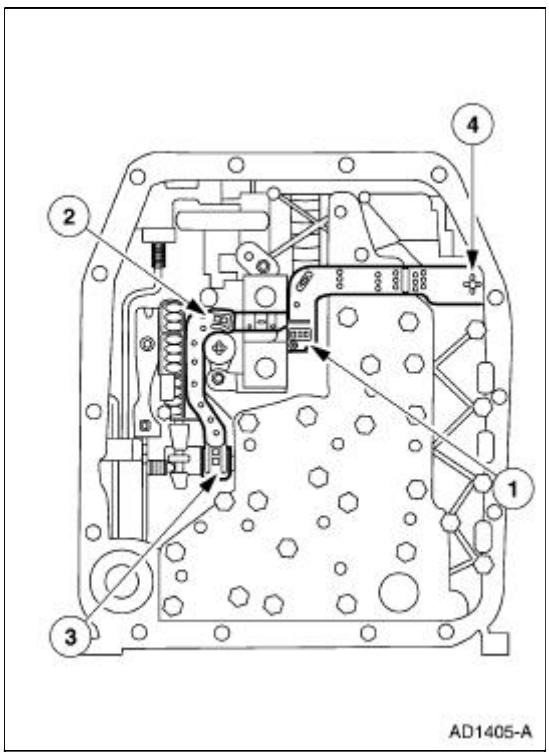
ST2545-A	Gauge, Transmission Solenoid Connectors 307-426

Removal

1. Drain transmission fluid and remove the transmission fluid pan and filter. For additional information, refer to Fluid Pan, Gasket and Filter .

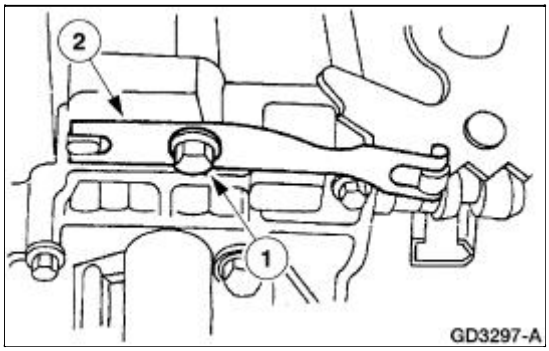
2. **CAUTION: Do not pull on the molded lead frame. This may cause damage to the connector ends. Carefully pry up on the locking tabs to disconnect the solenoids. Disconnect the molded lead frame from the solenoids.**

   Disconnect the molded lead frame from the solenoids.
   1. Disconnect the shift solenoid SSA and SSB.
   2. Disconnect the torque converter clutch (TCC).
   3. Disconnect the electronic pressure control (EPC) solenoid.
   4. Disconnect the bulkhead inter-connector.

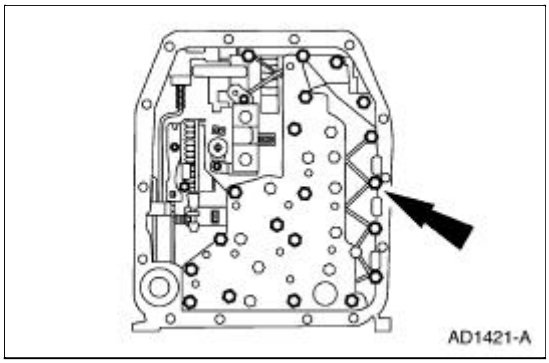


3. Remove the manual control valve detent lever spring.
   1. Remove the bolt.

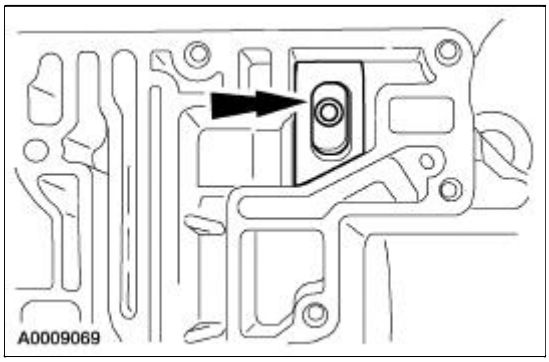
2. Remove the manual control valve detent lever spring.



4. Remove the 24 valve body-to-case bolts.



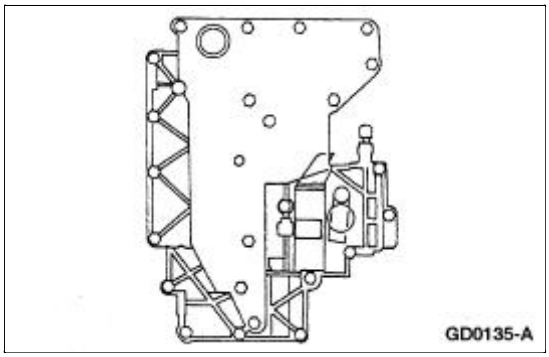
5. Remove the main control valve body and discard the pump outlet screen.



Installation

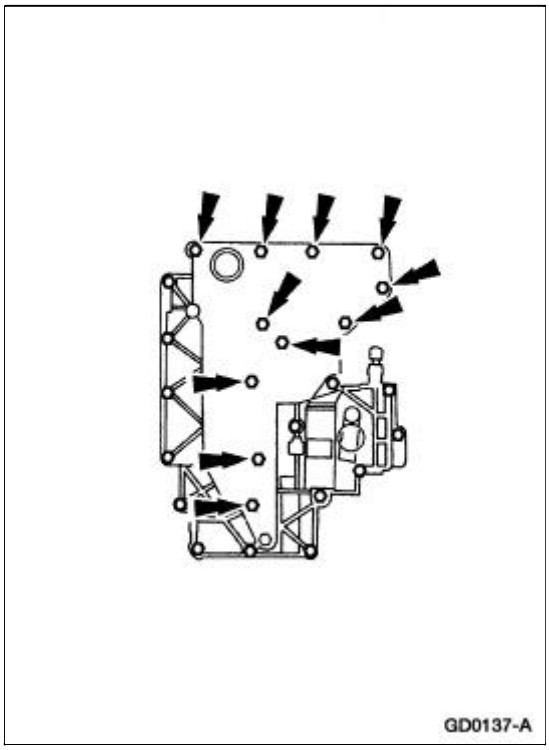
1. **NOTE:** Make sure that the drive pin of the manual valve detent lever assembly engages the manual valve in the correct location prior to installing the bolts.

   Position the main control valve body gasket and main control valve body using the two alignment bolts as a guide.



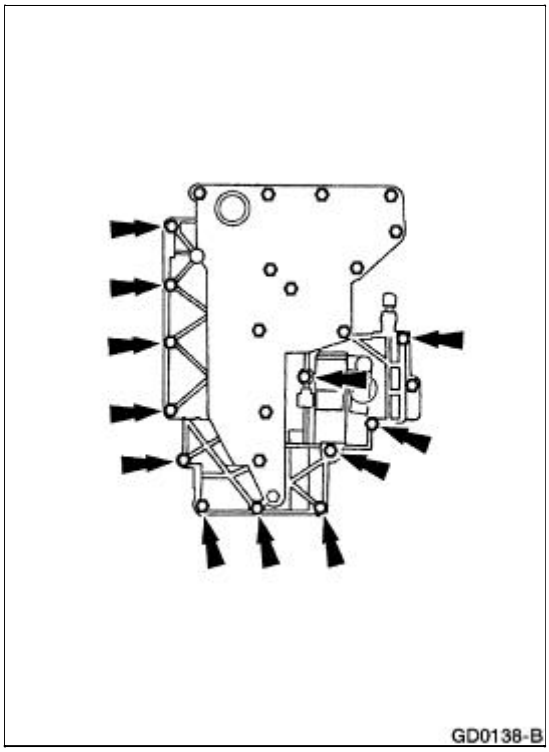
2. **NOTE:** The main control valve body bolts will be tightened in later steps.

   Loosely install the bolts.

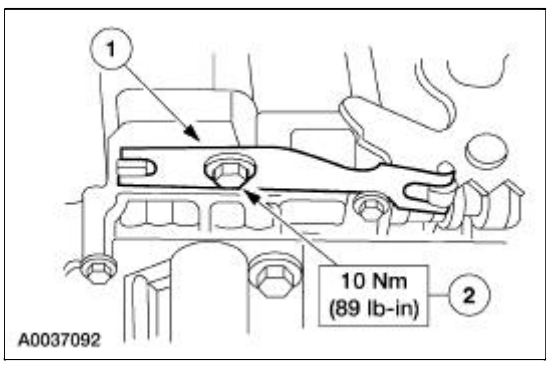


3. **NOTE:** The main control valve body bolts will be tightened in later steps.

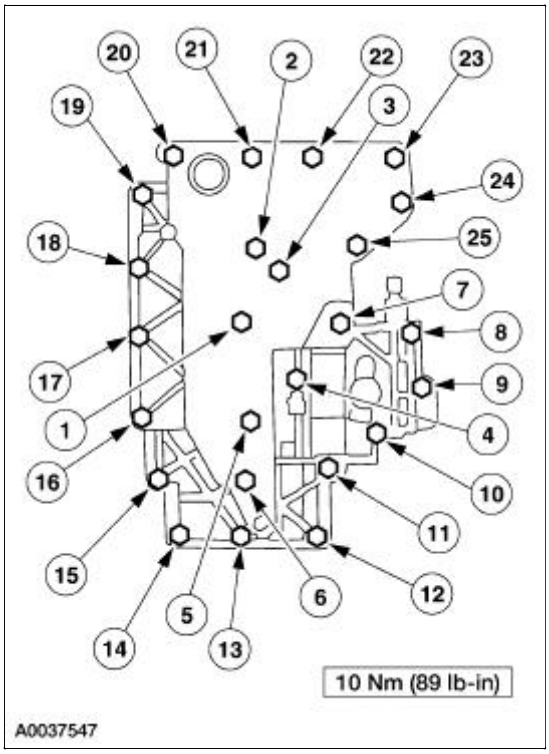
   Loosely install the bolts.



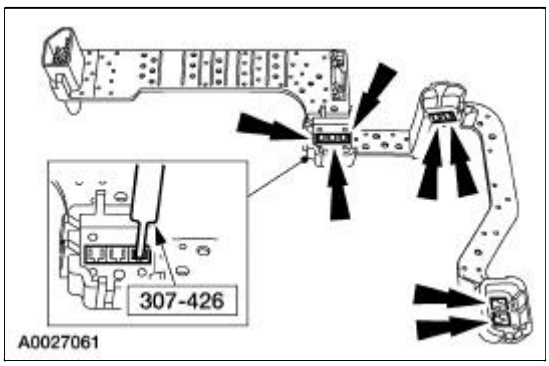
4. Install the manual control valve detent lever spring.
    1. Position the manual control valve detent lever spring.
    2. Install the bolt.



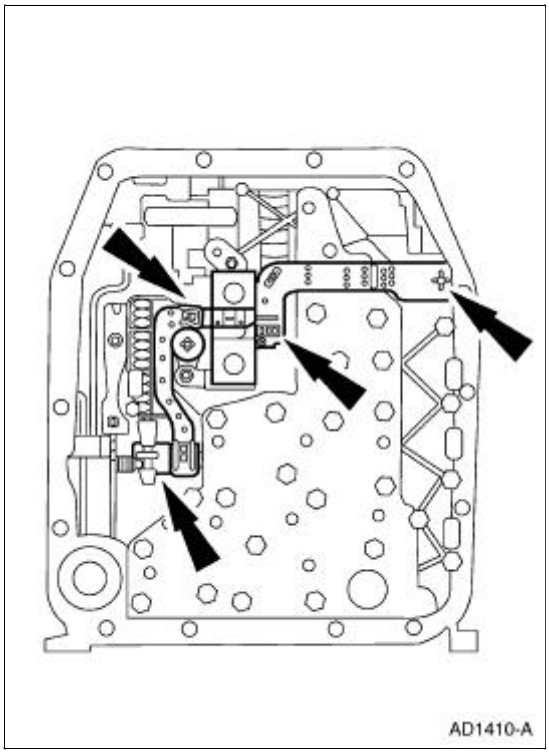
5. Tighten the main control valve body bolts in the sequence shown.



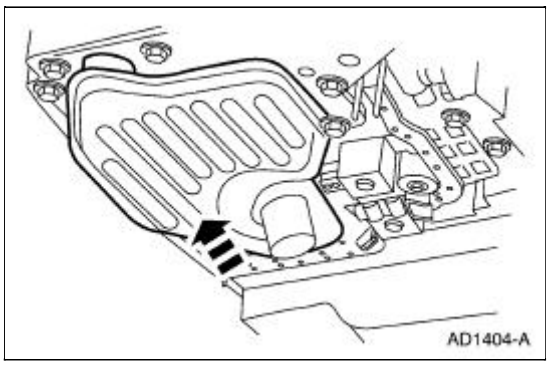
6. Inspect the lead frame for damage.
    - Using the special tool, check all lead frame solenoid connections. The gauge should fit tightly and not fall out after being inserted.
    - If the special tool passes through any lead frame connector pins or does not feel like it makes a good contact, install a new lead frame.



7. Connect the molded lead frame to the solenoids.
    - Connect the bulkhead inter-connector by pressing it in place by hand and fully seating the connector in place.
    - Connect the EPC solenoid by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.
    - Connect the TCC by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.
    - Connect the shift solenoid SSA and SSB by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.



8. Install the transmission filter and pan. For additional information, refer to Fluid Pan, Gasket and Filter in this section.



Extension Housing Seal and Gasket

Special Tool(s)

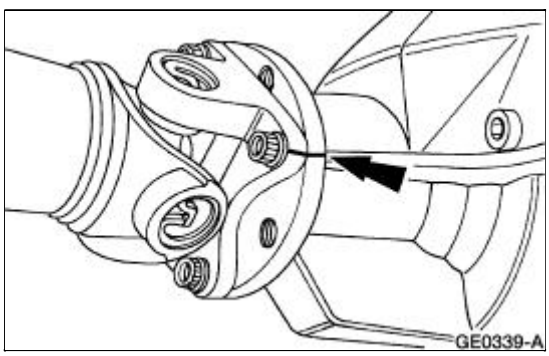
ST1185-A	Slide Hammer 100-001 (T50T-100-A)
ST1188-A	Installer, Transmission Extension Housing Fluid Seal 308-002 (T61L-7657-A)
ST1192-A	Remover, Transmission Fluid Seal 307-048 (T74P-77248-A)

Removal

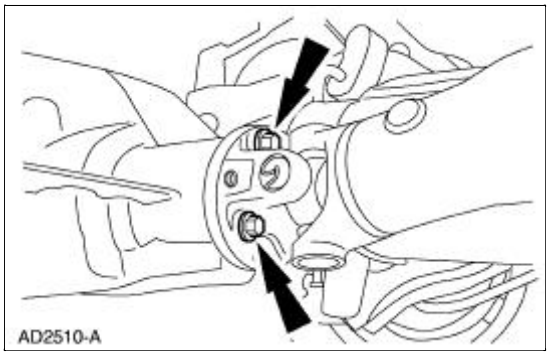
1. Drain the transmission fluid. For additional information, refer to Fluid Pan, Gasket and Filter in this section.

2. **NOTE:** The output shaft and driveshaft are a balanced assembly.

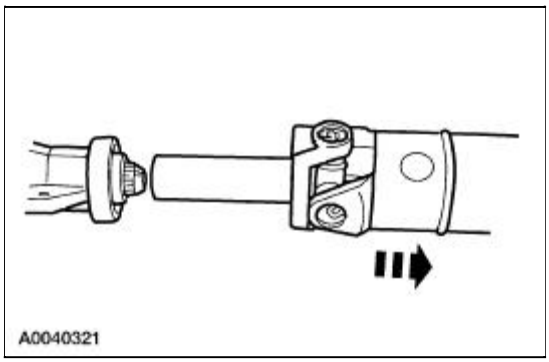
   Mark the driveshaft flange and the rear companion flange for correct alignment during assembly.



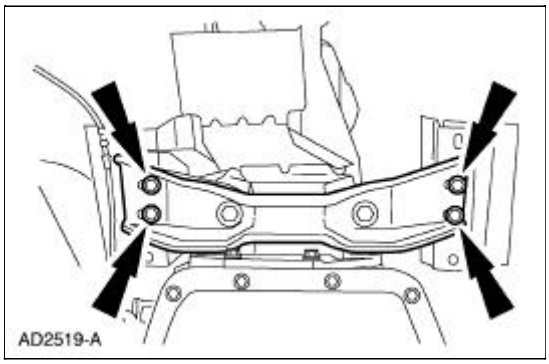
3. Remove the four driveshaft bolts.



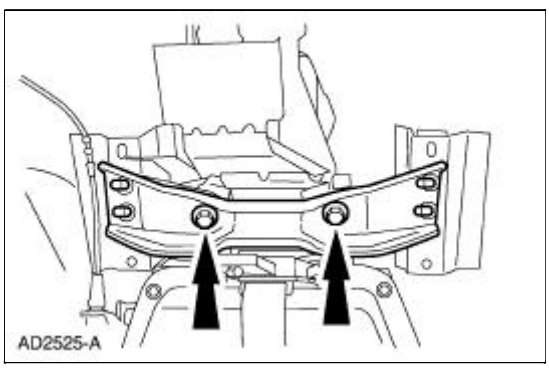
4. Separate the driveshaft from the transmission.



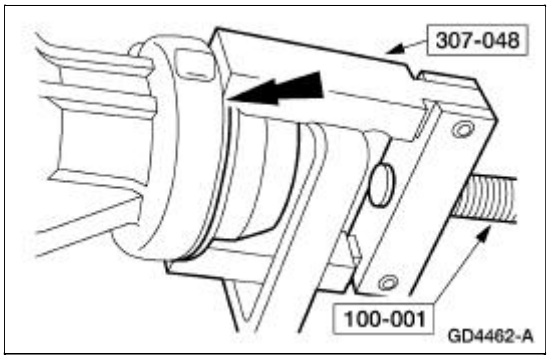
5. Use a high-lift transmission jack to support the transmission.
6. Remove the transmission crossmember bolts.



7. Remove the transmission mount and crossmember.

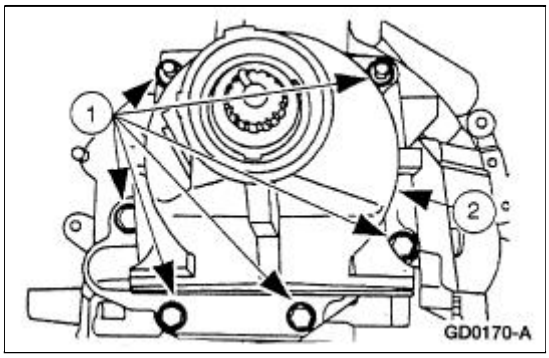


8. Using the special tools, remove the extension housing seal.



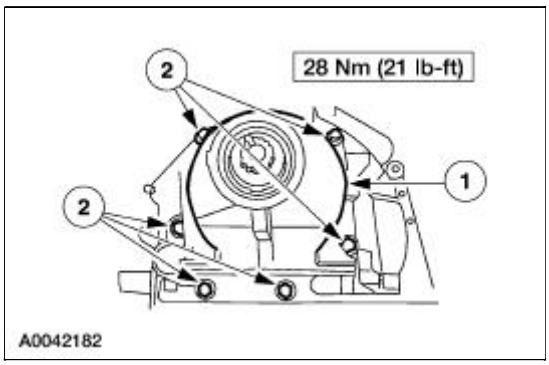
9. Lower the transmission to access the extension housing bolts.

10. Remove the extension housing and gasket.
    1. Remove the bolts and the nuts.
    2. Remove the extension housing and gasket.

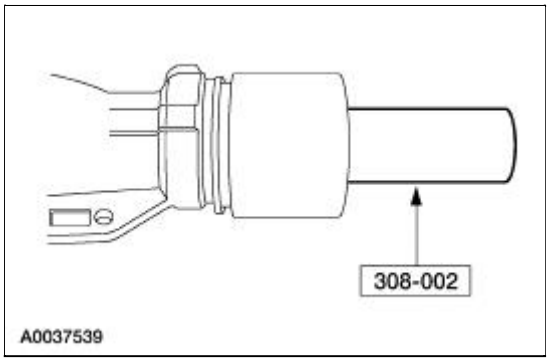


Installation

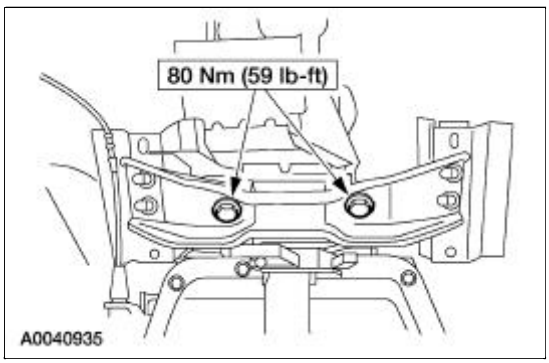
1. Install the extension housing and gasket.
    1. Install the extension housing gasket and housing.
    2. Install the bolts and the nuts.



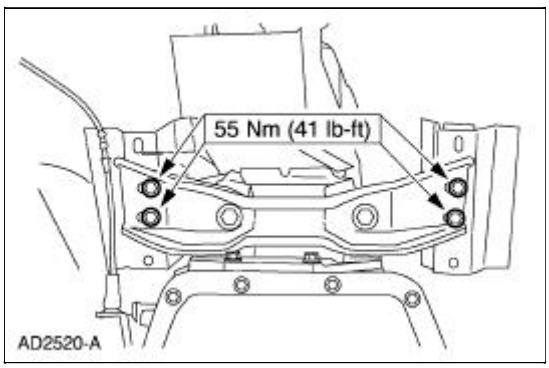
2. Using the special tool, install the new extension housing seal.



3. Raise and position the transmission.
4. Install the transmission mount and crossmember.

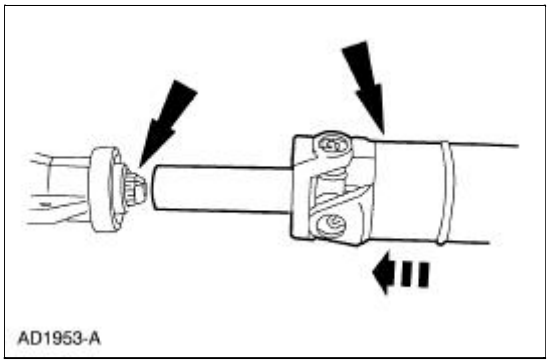


5. Install the transmission crossmember bolts.



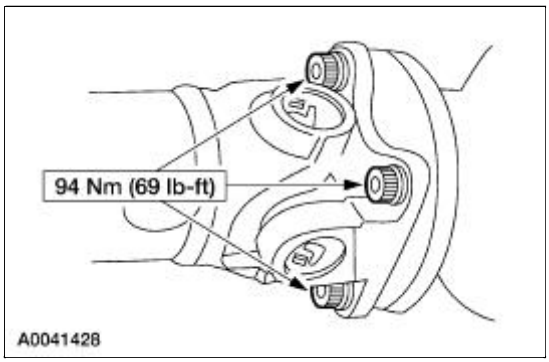
6. Remove high-lift transmission jack.
7. **NOTE:** The output shaft and the driveshaft are a balanced assembly.

   Install the driveshaft.
   - Align the yellow dots and position the driveshaft on the transmission.
   - Install the driveshaft.



8. **NOTE:** To maintain driveshaft balance, align the marks made during disassembly for the rear axle flange and the driveshaft yoke.

   Install the four bolts.



9. Install the filter and pan. For additional information, refer to Fluid Pan, Gasket and Filter in this section.

Electronic Pressure Control (EPC) Solenoid

Special Tool(s)

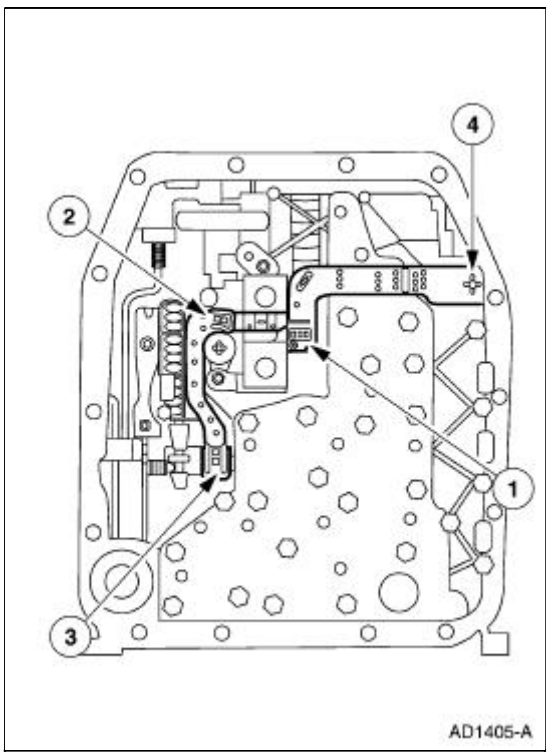
ST2545-A	Gauge, Transmission Solenoid Connectors 307-426

Removal

1. Remove the manual control lever. For additional information, refer to Manual Control Lever Shaft and Seal in this section.

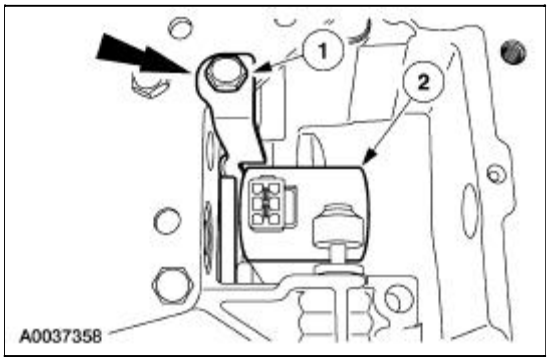
2. **CAUTION: Do not pull on the molded lead frame. This may cause damage to the connector ends. Carefully pry up on the locking tabs to disconnect the solenoids. Disconnect the molded lead frame from the solenoids.**

   Disconnect the molded lead frame from the solenoids.
   1. Disconnect the shift solenoid SSA and SSB.
   2. Disconnect the torque converter clutch (TCC).
   3. Disconnect the electronic pressure control (EPC) solenoid.
   4. Disconnect the bulkhead inter-connector.



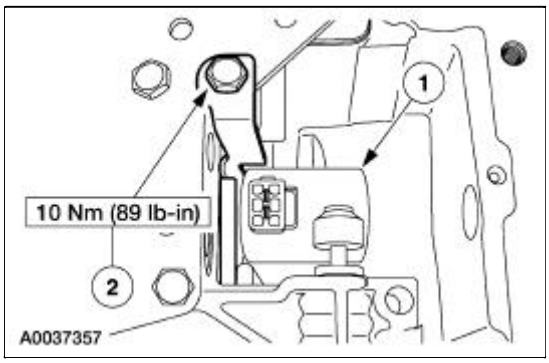
3. Remove the EPC solenoid.
   1. Remove the bolt and EPC solenoid bracket.

2. Remove the EPC solenoid.

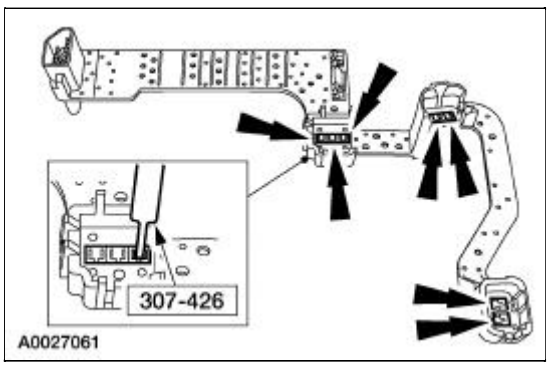


Installation

1. Install the EPC solenoid.
    1. Install the EPC solenoid.
    2. Install the EPC solenoid bracket and bolt.



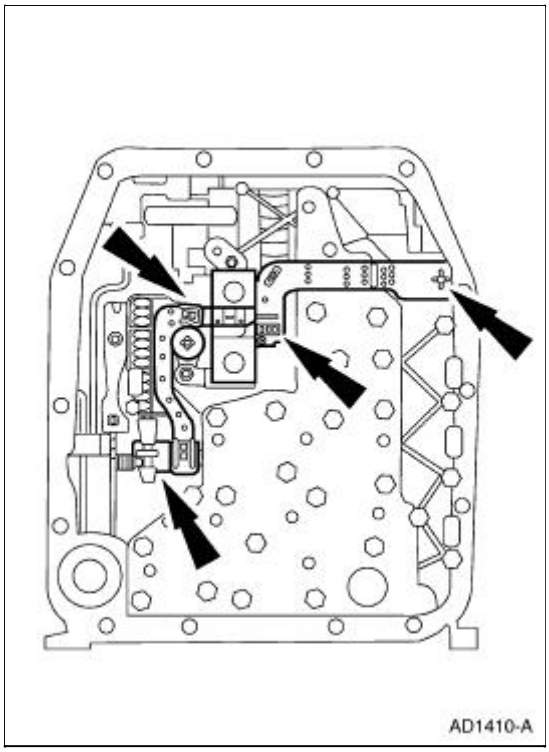
2. Inspect the lead frame for damage.
    - Using the special tool, check all lead frame solenoid connections. The gauge should fit tightly and not fall out after being inserted.
    - If the special tool passes through any lead frame connector pins or does not feel like it makes a good contact, install a new lead frame.



3. Connect the molded lead frame to the solenoids.
    - Connect the bulkhead inter-connector by pressing it in place by hand and fully seating the connector in place.
    - Connect the EPC solenoid by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.
    - Connect the TCC by pressing it in place by hand and fully seating the connector in place.

Make sure that the terminals pass fully through the connector slots.

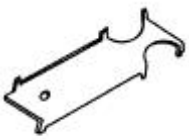
- Connect the shift solenoid SSA and SSB by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.



4. Install the manual control lever. For additional information, refer to Manual Control Lever Shaft and Seal in this section.

Manual Control Lever Shaft and Seal

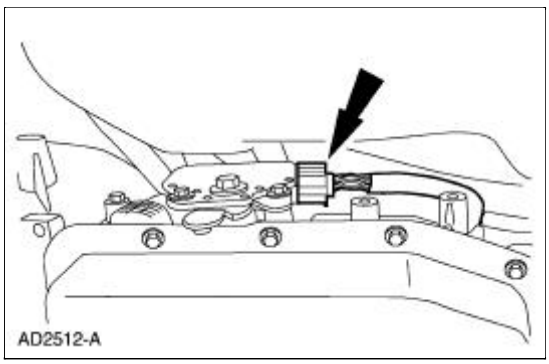
Special Tool(s)

ST1199-A	Installer, Shift Shaft Fluid Seal 307-050 (T74P-77498-A)
 ST1633-A	Alignment Gauge, TR Sensor 307-351 (T97L-70010-A)

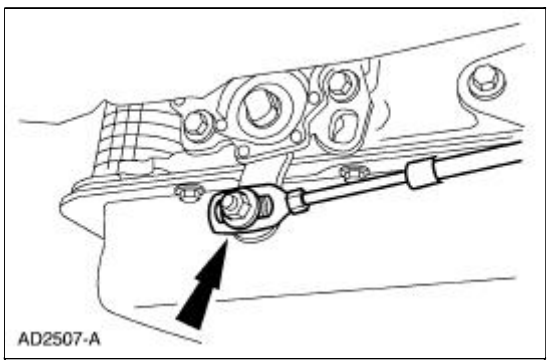
Removal

1. Drain the transmission fluid and remove the fluid pan and filter. For additional information, refer to Fluid Pan, Gasket and Filter in this section.

2. Disconnect the digital transmission range (TR) sensor electrical connector.

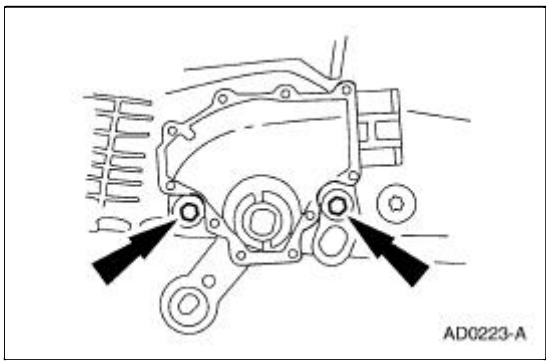


3. Disconnect the transmission shift linkage.

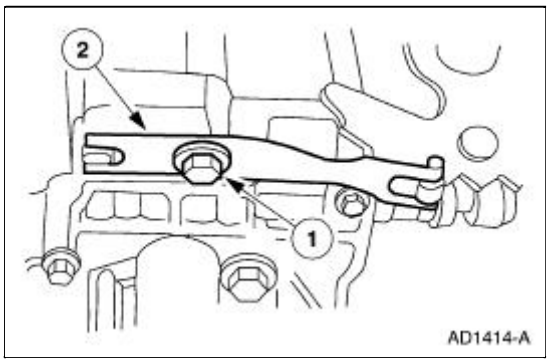


4. Remove the digital TR sensor.

- Remove the bolts.
- Remove the digital TR sensor.

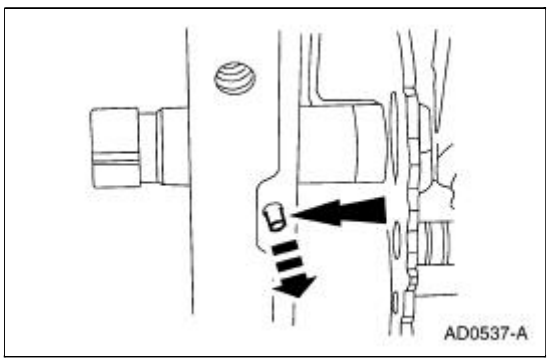


5. Remove the manual control valve detent lever spring.
    1. Remove the bolt.
    2. Remove the manual control valve detent lever spring.

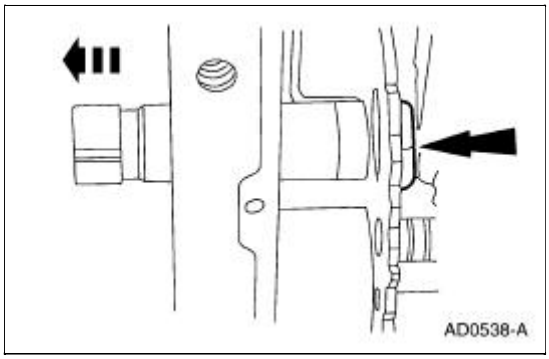


6. **NOTE:** Use a shop cloth to protect the transmission case surface.

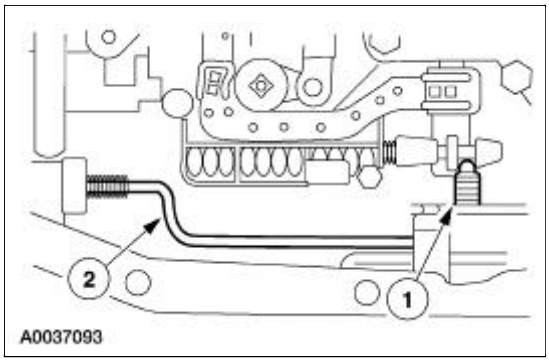
    Remove the manual lever shaft retaining pin.



7. Remove the nut and slide the manual control lever shaft out of the case.

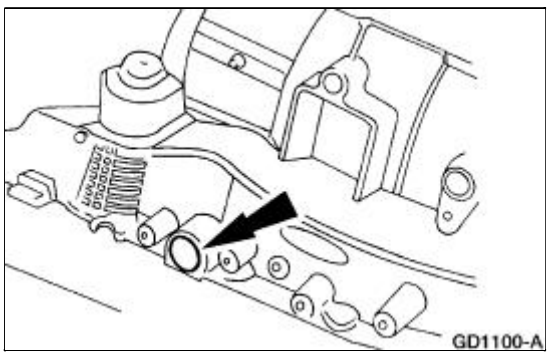


8. Remove the parking lever actuating rod.
    1. Remove the manual valve detent lever.
    2. Remove the parking lever actuating rod.



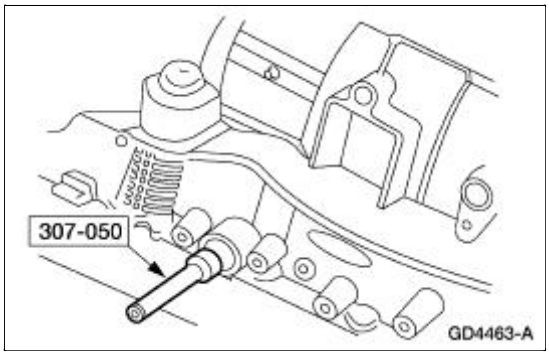
9. **CAUTION: Use care not to damage the manual control lever shaft bore. New seal may leak due to damage to the bore.**

    Remove the manual control lever shaft seal.

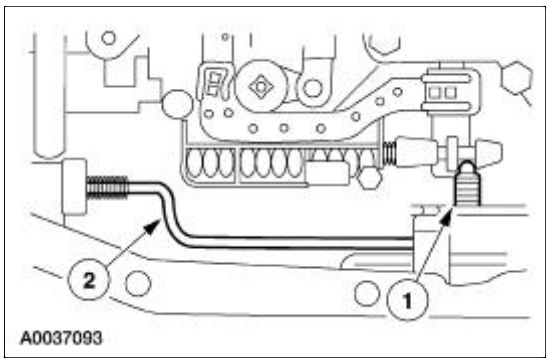


Installation

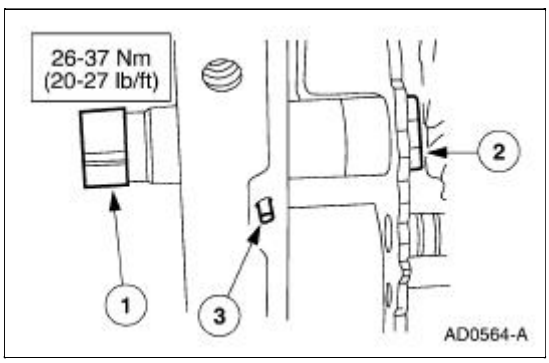
1. Using the special tool, install the manual control lever seal.



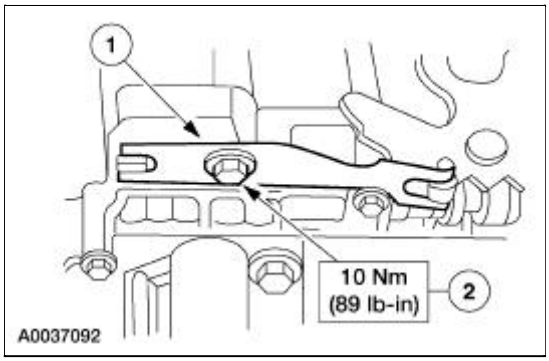
2. Install the parking lever actuating rod.
    1. Install the parking lever actuating rod.
    2. Install the manual valve detent lever.



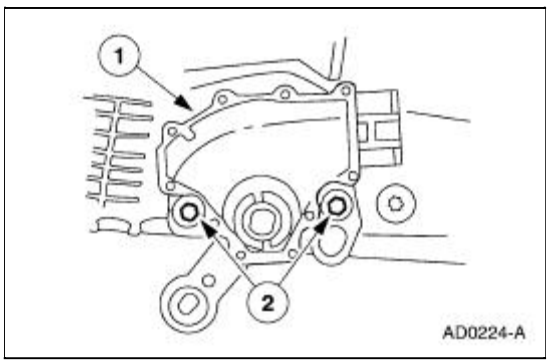
3. Install the manual control lever shaft.
    1. Install the manual control lever shaft.
    2. Install the nut.
    3. Install the manual lever shaft retaining pin.



4. Install the manual valve detent lever spring.
    1. Position the manual valve detent lever spring.
    2. Install the bolt.



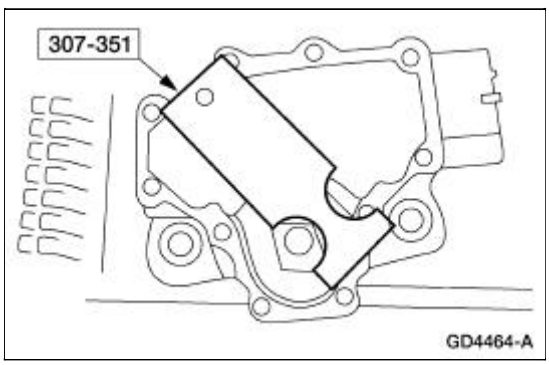
5. Install the digital TR sensor.
    1. Install the digital TR sensor.
    2. Loosely install the bolts.



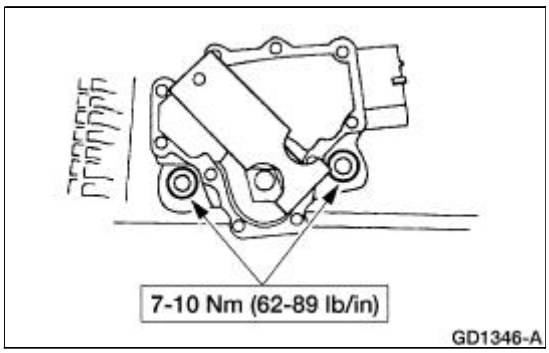
6. **NOTE:** The tool is designed to fit snug.

    NOTE: Manual shift lever shaft must be in the neutral position.

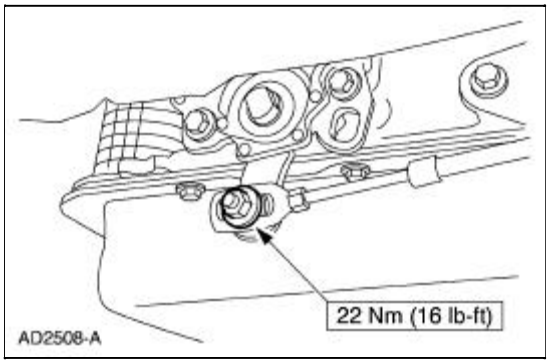
    Using the special tools, align the digital TR sensor slots.



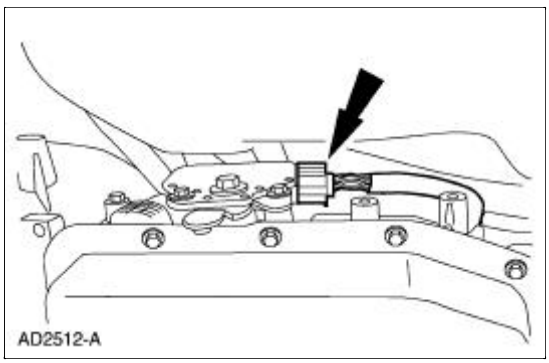
7. Tighten the bolts.



8. With manual lever in overdrive, connect the shift control cable.



9. Install the digital TR sensor electrical connector.



10. Install the filter and transmission fluid pan. For additional information, refer to Fluid Pan, Gasket and Filter in this section.

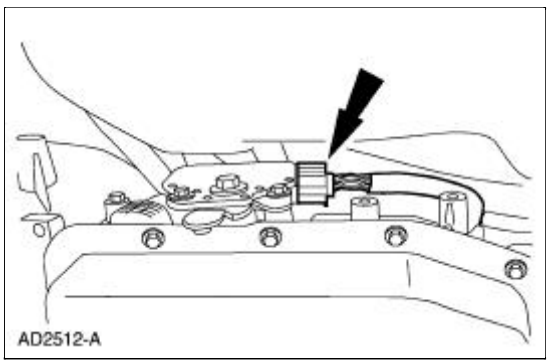
Digital Transmission Range (TR) Sensor

Special Tool(s)

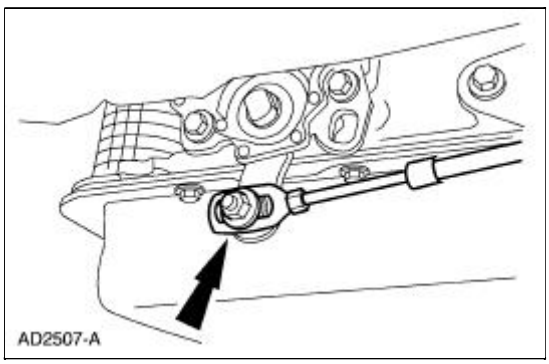
ST1633-A	Alignment Gauge, TR Sensor 307-351 (T97L-70010-A)

Removal

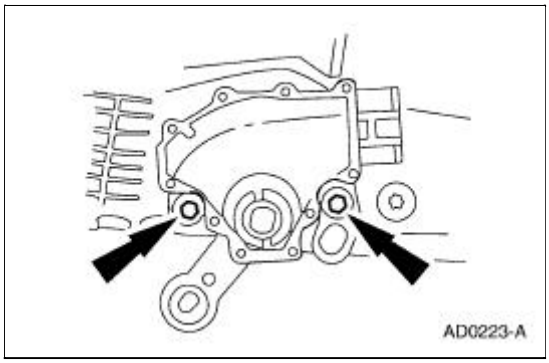
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Disconnect the connector.


AD2512-A

4. Disconnect the manual lever shift control cable.

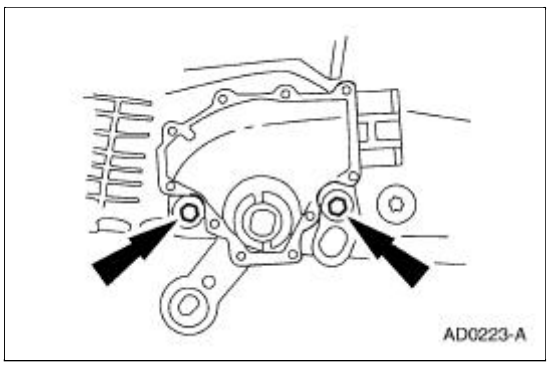

AD2507-A

5. Remove the digital TR bolts and the TR sensor.



Installation

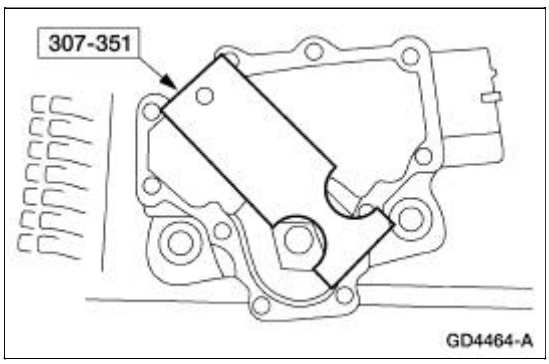
1. Install the digital TR sensor and loosely install the bolts.



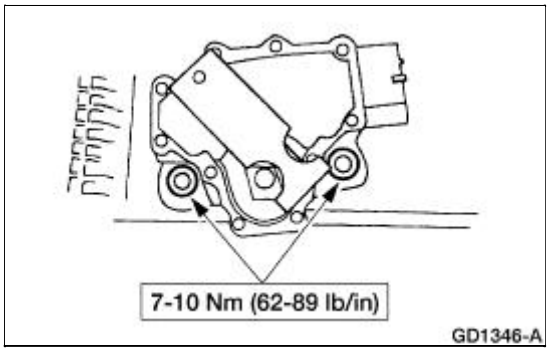
2. **NOTE:** The tool is designed to fit snugly.

   NOTE: Manual shift lever shaft must be in the neutral position.

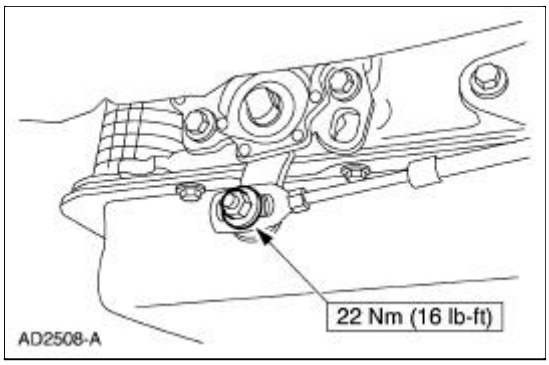
   Using the special tool, align the digital TR sensor slots.



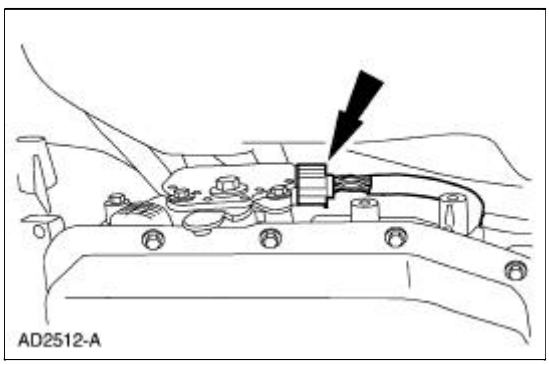
3. Tighten the bolts.



4. With the manual lever in overdrive connect the shift lever control cable.



5. Install the digital TR sensor electrical connector.



6. Lower the vehicle.

7. **NOTE:** When the battery is disconnected and reconnected, some abnormal driving symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.

   Connect the battery ground cable.

Reverse Servo Assembly

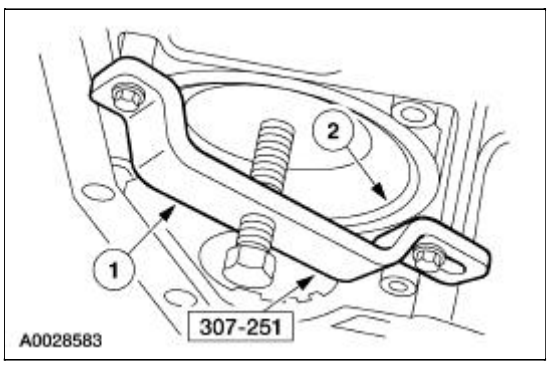
Special Tool(s)

ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
ST1210-A	Remover/Installer, Servo Piston 307-251 (T92P-70023-A)
ST1202-A	Installer, Servo Piston 307-073 (T80L-77030-A)

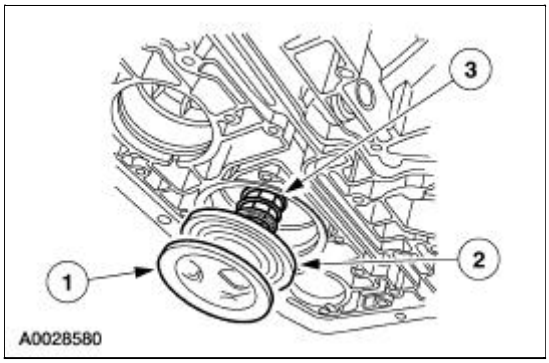
Removal

1. Remove the main control valve body. For additional information, refer to Main Control Valve Body in this section.

2. Using the special tool, remove the reverse band servo retaining ring.
   1. Compress the servo spring.
   2. Remove the reverse band servo retaining ring.



3. Remove the reverse servo assembly.
   1. Remove the reverse band servo cover.
   2. Remove the reverse band servo piston and rod.
   3. Remove the reverse band servo spring.

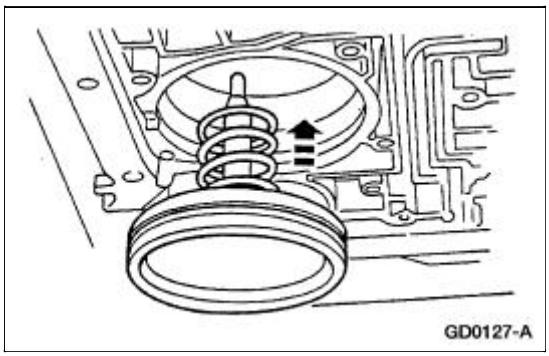


Installation

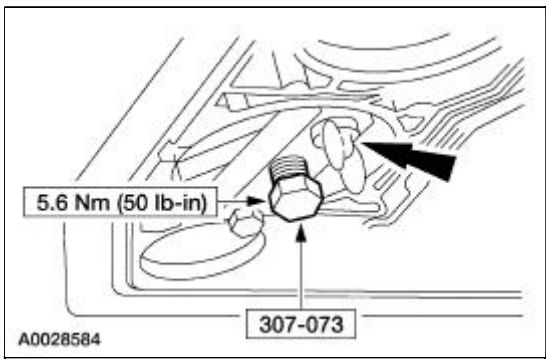
NOTE: This is not an ordinary installation procedure and does not compensate for band wear.

1. **NOTE:** Lubricate the reverse piston seal to facilitate assembly and prevent damage to the seal.

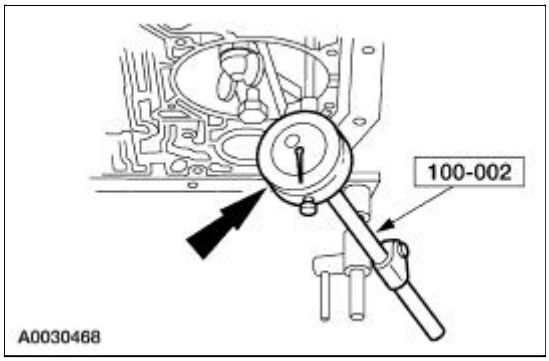
   Install the reverse servo return spring and piston.
   - Do not install the piston cover.



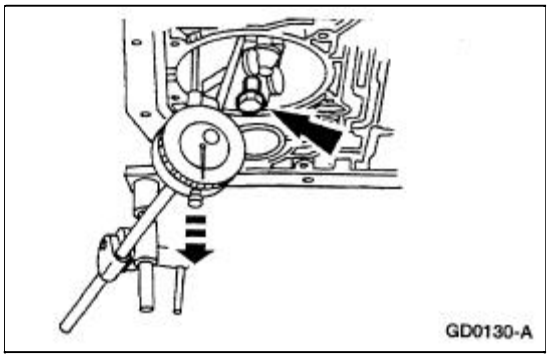
2. Install the special tool and tighten the band apply bolt.



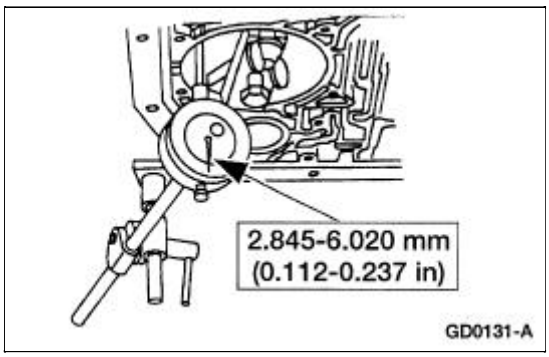
3. Attach the special tool to the transmission.
   - Position the indicator stem on the flat portion of the reverse servo piston and zero the dial indicator.



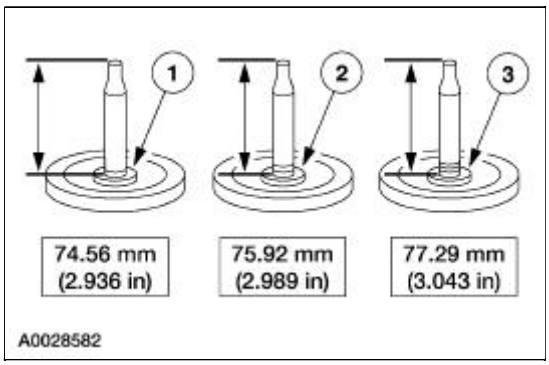
4. Loosen the bolt until the piston stops against the tool.



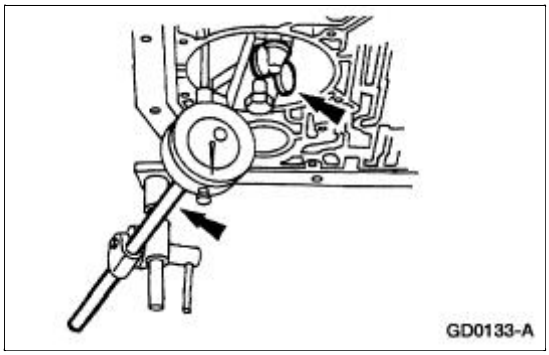
5. Verify that the amount of piston travel on the dial indicator is within specification.



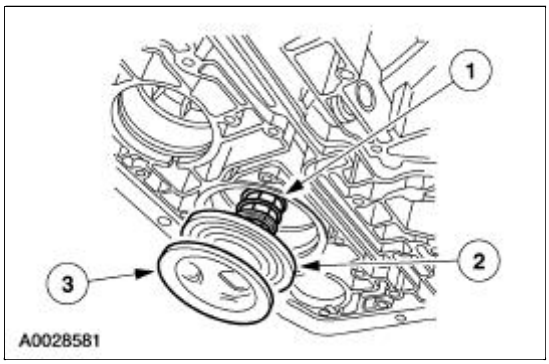
6. If piston travel is not within specification, select and install the correct servo piston assembly to bring the servo piston travel within specification.
    1. One groove
    2. Two groove
    3. Three groove



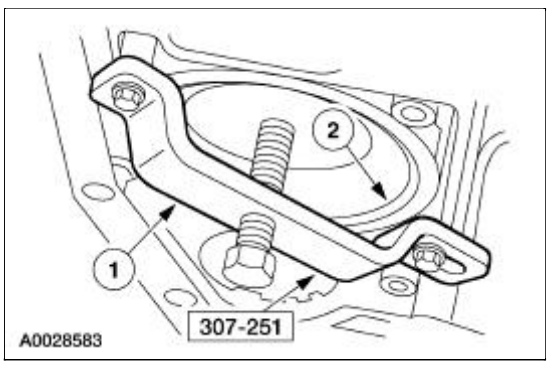
7. Remove the dial indicator and servo selection tool.



8. Install the correct reverse servo assembly.
    1. Install the reverse band servo spring.
    2. Install the reverse band servo piston and rod.
    3. Install the reverse band servo cover.



9. Using the special tool, install the reverse servo retaining ring.
    1. Compress the servo spring.
    2. Install the reverse band servo retaining ring.



10. Install the main control valve body. For additional information, refer to Main Control Valve Body in this section.

Overdrive Servo

Special Tool(s)

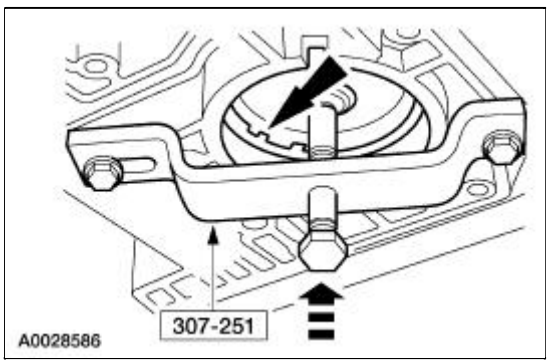
ST1210-A	Remover/Installer, Servo Piston 307-251 (T92P-70023-A)

Removal

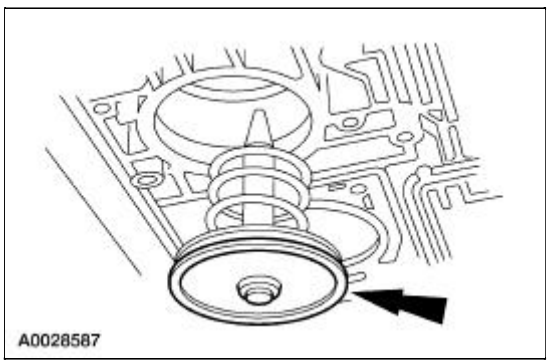
1. Remove the main control valve body. For additional information, refer to Main Control Valve Body in this section.

2. **NOTE:** If the tool is not available, extreme care must be taken. Spring pressure will force overdrive servo piston assembly out of case. Case bore damage may result from trying to pry on overdrive servo internal retaining ring.

   Using the special tool, compress the servo spring to remove the overdrive servo retaining ring.



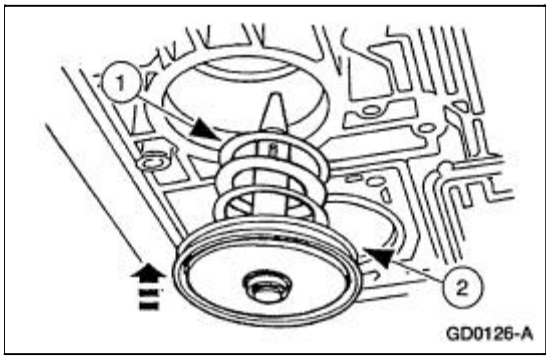
3. Remove the overdrive servo piston and return spring.



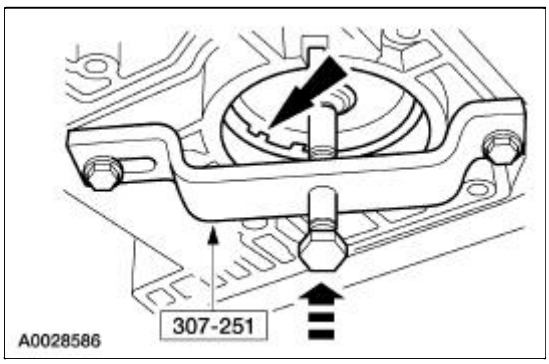
Installation

1. Install the overdrive servo piston assembly.
   1. Install the overdrive servo piston return spring.

2. Install the overdrive servo piston assembly.



2. Use the special tool to install the overdrive servo piston retaining ring.

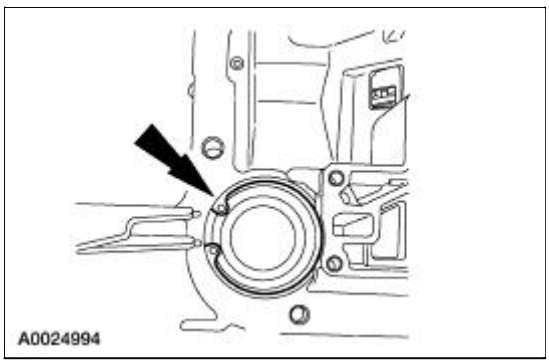


3. Install the main control valve body. For additional information, refer to Main Control Valve Body in this section.

1-2 Accumulator

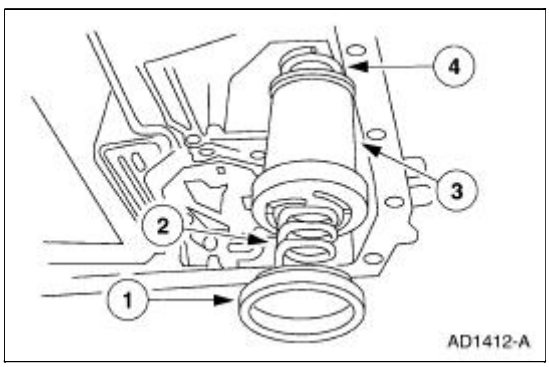
Removal

1. Compress the 1-2 accumulator cover and remove the accumulator piston retaining ring.



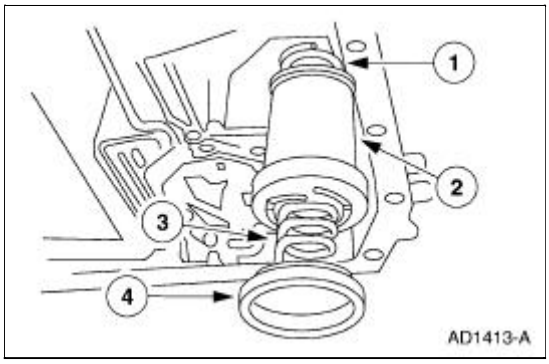
2. **NOTE:** Note the location of the 1-2 accumulator springs for reference during assembly.

   Remove the 1-2 accumulator.
   1. Remove the 1-2 accumulator cover.
   2. Remove the lower 1-2 accumulator spring.
   3. Remove the accumulator piston.
   4. Remove the upper 1-2 accumulator spring.

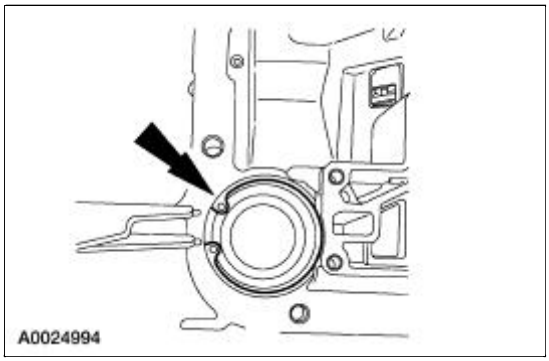


Installation

1. Install the 1-2 accumulator.
   1. Install the 1-2 accumulator upper spring.
   2. Install the accumulator piston.
   3. Install the 1-2 accumulator lower spring.
   4. Install the cover and seal assembly.



2. Compress the accumulator and install the accumulator piston retaining ring.

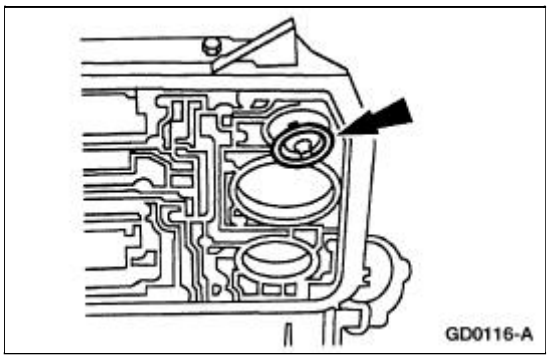


2-3 Accumulator

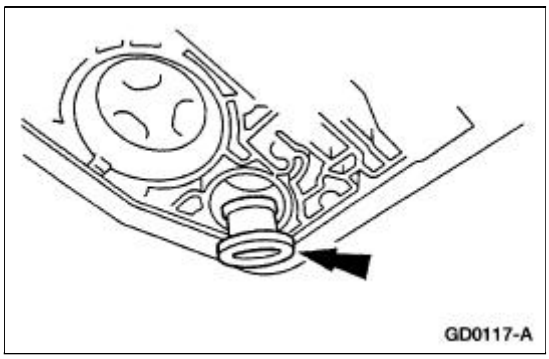
Removal

1. Remove the main control valve body. For additional information, refer to Main Control Valve Body in this section.

2. Remove the 2-3 accumulator piston retainer.

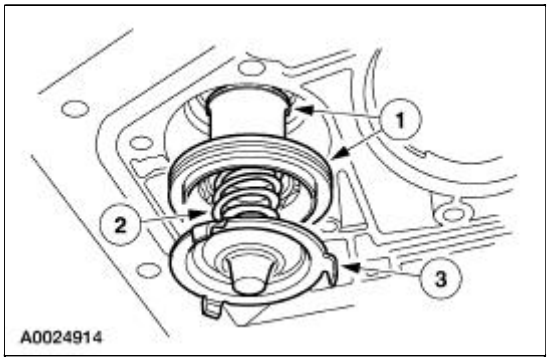


3. Remove the accumulator piston and spring.



Installation

1. Install the 2-3 accumulator assembly.
    1. Install the accumulator piston.
    2. Install the accumulator piston spring.
    3. Install the accumulator spring retainer.

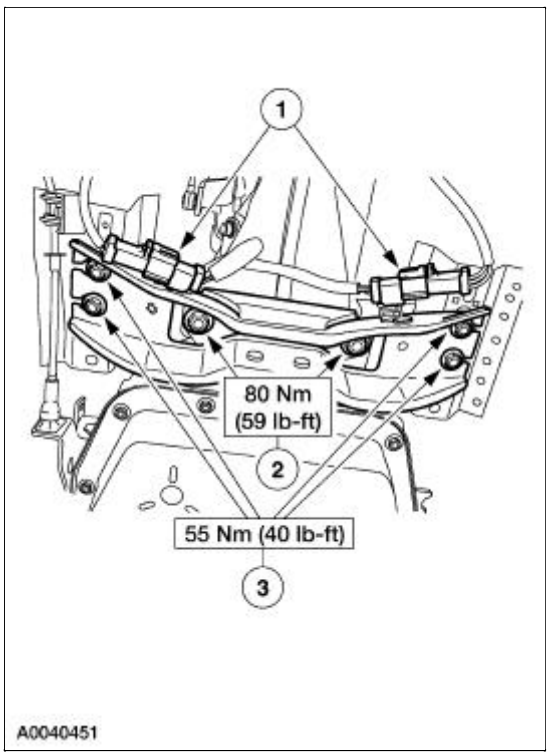


2. Install the main control valve body. For additional information, refer to Main Control Valve Body in this section.

Transmission Support Crossmember

Removal and Installation

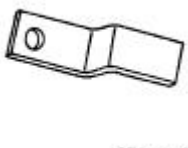
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Support the transmission with a suitable transmission jack.
3. Remove the crossmember.
    1. Disconnect the HO2S sensors and position them aside.
    2. Remove the bolts from the crossmember to the extension housing.
    3. Remove the bolts from the crossmember to the body and remove the crossmember.



4. To install, reverse the removal procedure.

Transmission

Special Tool(s)

 ST1636-A	Retainer, Torque Converter 307-346 (T97T-7902-A)

CAUTION: Whenever a transmission has been disassembled to install new parts the transmission fluid cooler tubes must be cleaned and backflushed. Use a suitable torque converter/fluid cooler cleaner. If equipped a new oil-to-air cooler must also be installed.

When internal wear or damage has occurred in the transmission, metal particles, clutch plate material or band material may have been carried into the torque converter and fluid cooler. These contaminants are a major cause of recurring transmission troubles and must be removed from the system before the transmission is put back into use.

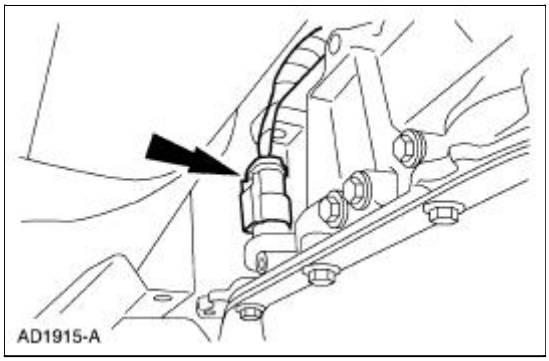
CAUTION: After transmission is removed for a major overhaul, it is important to completely clean all transmission components, including torque converter, oil-to-air cooler if equipped, cooler inlet tube, main control valve body, clutches and all coasting booster valve shuttle balls after any transmission repair that generates contamination. These contaminants are a major cause for recurring transmission concerns and must be removed from the system before the transmission is returned to use.

The cleaning of foreign material from the direct clutch check ball is often omitted. This omission can lead to repeat repair of the transmission.

If equipped a new oil-to-air cooler must be installed under the following conditions; for installation refer to Section 307-02 .

- **Evidence of transmission assembly or fluid contamination is found due to the following transmission or converter failure modes:**
  - **major metallic failure**
  - **multiple clutches or clutch plate failures**
  - **sufficient component wear which results in metallic contamination.**

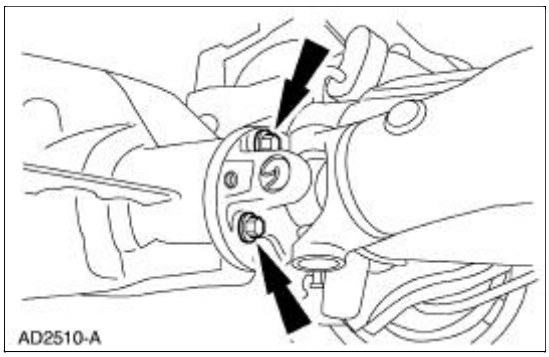
1. Place the transmission range selector lever in NEUTRAL.
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. Raise and support the vehicle. For additional information, refer to Section 100-02 .
4. Remove the dual converter Y pipe. For additional information, refer to Section 309-00 .
5. Disconnect the transmission harness electrical connector.



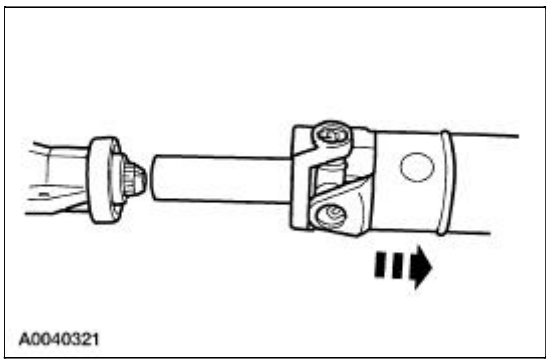
6. If transmission disassembly is required, drain the transmission fluid.

7. **NOTE:** To maintain the initial driveshaft balance, mark the REAR driveshaft yoke and the axle pinion flange so they may be installed in their original positions.

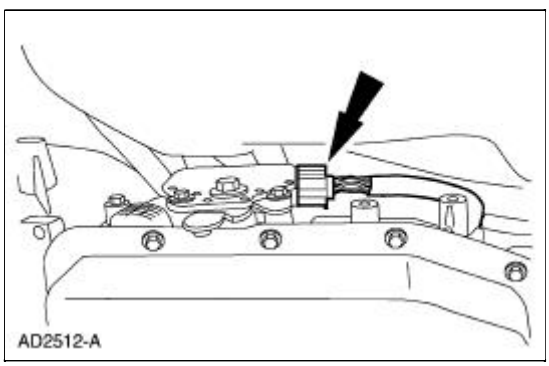
   Remove the driveshaft bolts.



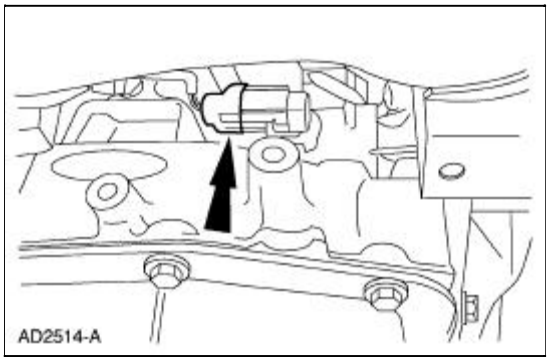
8. Separate the driveshaft from the transmission.



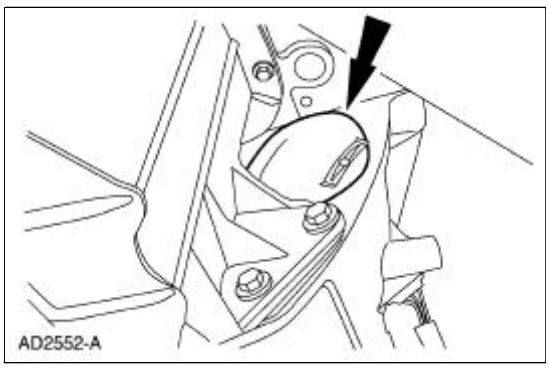
9. Disconnect the connector.



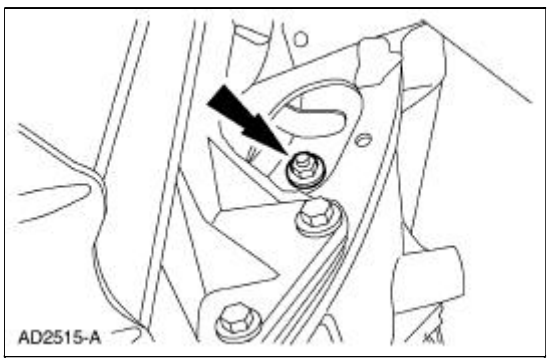
10. Disconnect the connector.



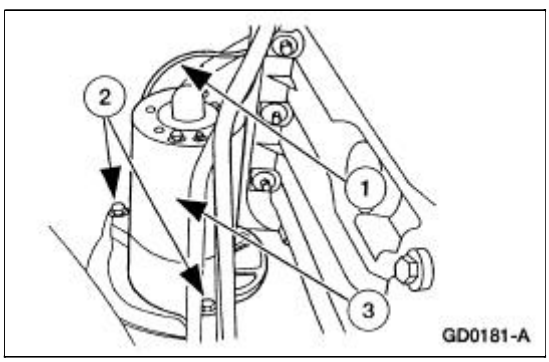
11. Remove the cover.



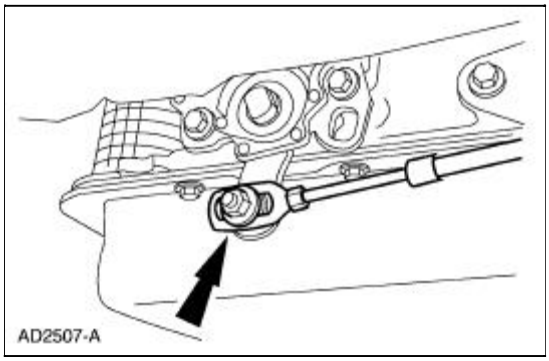
12. Remove the four nuts.



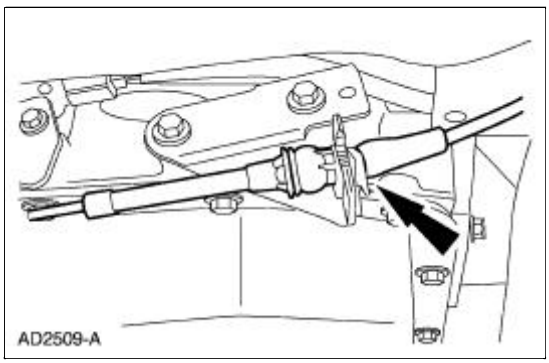
13. Remove the starter.
    1. Disconnect the electrical connectors.
    2. Remove the bolts.
    3. Remove the starter.



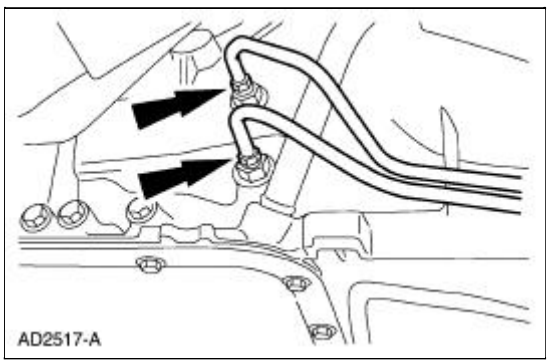
14. Disconnect the transmission shift linkage.



15. Remove the cable from the bracket.

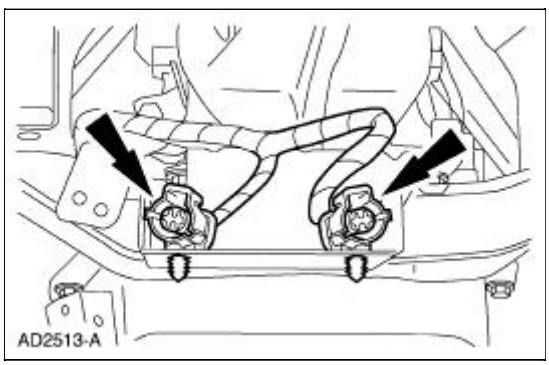


16. Disconnect the transmission fluid cooler tubes.

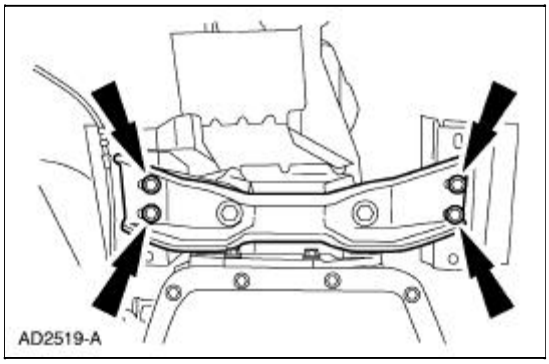


17. Position the high-lift jack under the transmission.

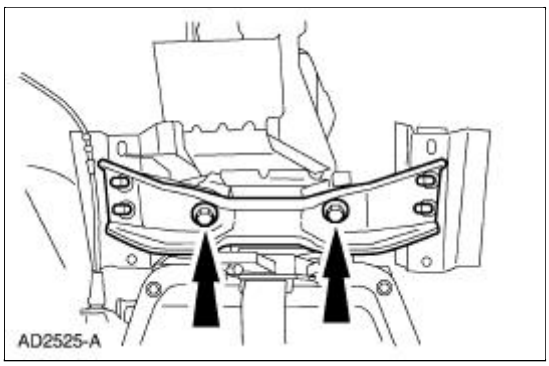
18. Unclip the connectors.



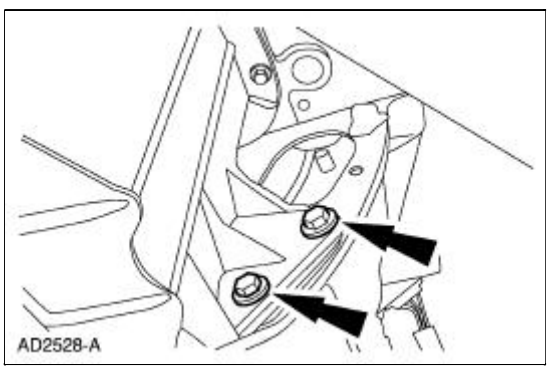
19. Remove the bolts.



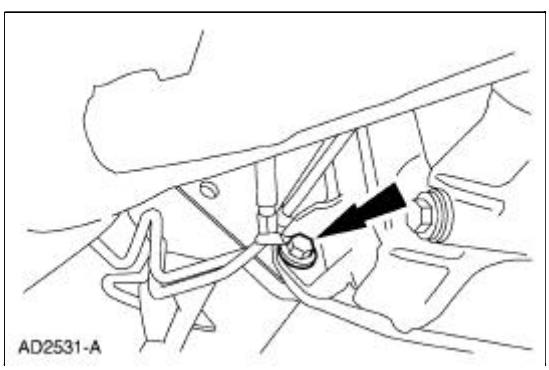
20. Remove the bolts.



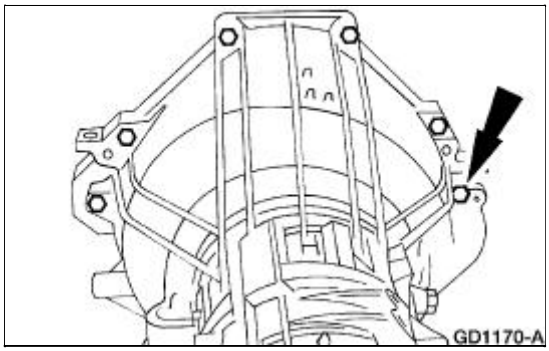
21. Remove the bolts.



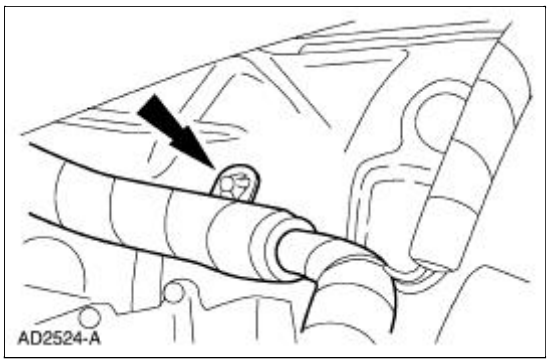
22. Remove the bolt.



23. Remove the bolts.

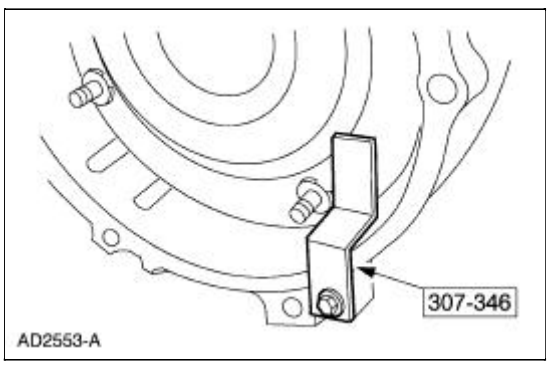


24. Unclip the harness.



25. **WARNING: The torque converter is heavy and may result in injury if it falls out of the transmission. Secure the torque converter in the transmission.**

    Using the special tool, secure the torque converter in the transmission then lower the transmission from the vehicle.



26. Carry out the transmission fluid cooler backflushing and cleaning. For additional information, refer to Transmission Fluid Cooler — Backflushing and Cleaning .

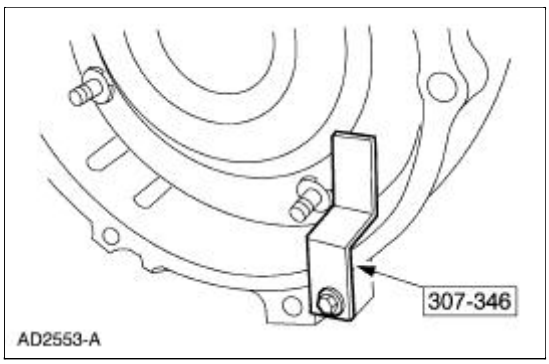
Transmission

Special Tool(s)

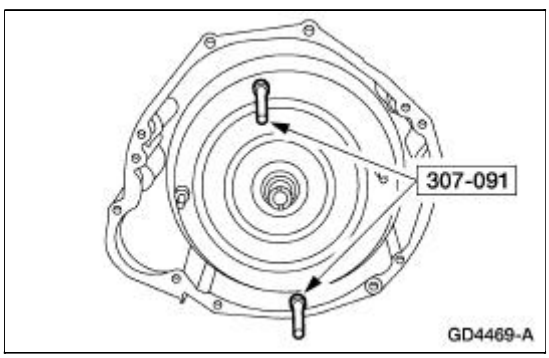
ST1185-A	Slide Hammer 100-001 (T50T-100-A)
ST1186-A	Holding Fixture, Transmission 307-003 (T57L-500-B)
ST1187-A	Slide Hammer 307-005 (T59L-100-B)
ST1192-A	Remover, Transmission Fluid Seal 307-048 (T74P-77248-A)
ST1631-A	Handle, Torque Converter 307-091 (T81P-7902-C)
ST1208-A	Remover, Transmission Fluid Pump 307-221 (T89T-70010-A)
ST1210-A	Remover/Installer, Servo Piston 307-251 (T92P-70023-A)
	Remover, Torque Converter Fluid Seal

ST1192-A	307-309 (T94P-77001-BH)
ST1636-A	Retainer, Torque Converter 307-346 (T97T-7902-A)
ST1200-A	Remover, Bearing Cup 308-047 (T77F-1102-A)

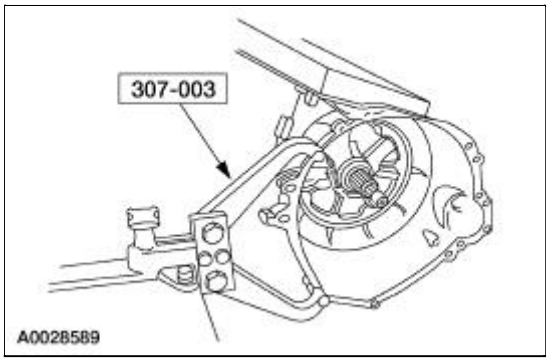
1. Remove the special tool.



2. Using the special tools, remove torque converter.

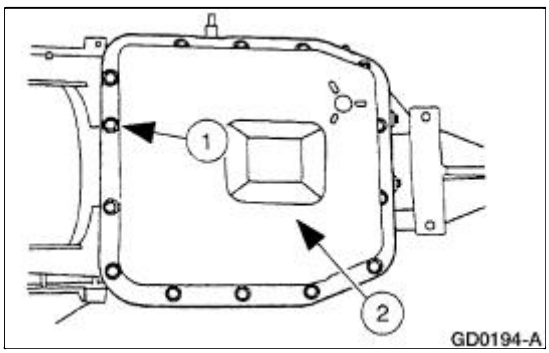


3. Using the special tool, mount the transmission to the bench.

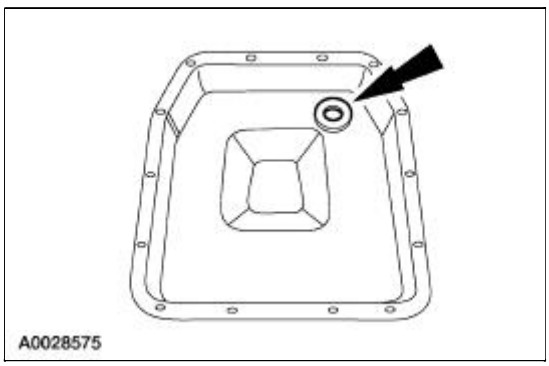


4. **NOTE:** If the transmission fluid pan gasket is not damaged, it may be reused.

   Remove the transmission fluid pan and transmission fluid pan gasket.
   1. Remove the bolts.
   2. Remove the transmission fluid pan and transmission fluid pan to case gasket.



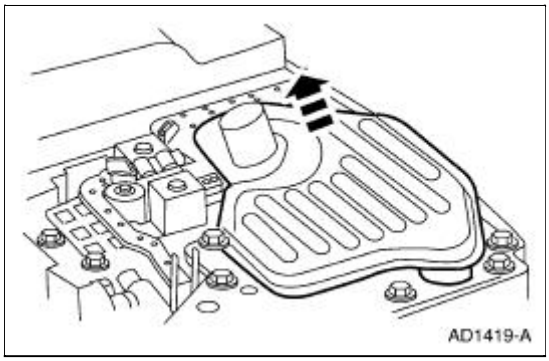
5. Clean the transmission fluid pan and pan magnet.



6. **CAUTION: If installing a new filter, and grommet remains in the main control bore, carefully use a small screwdriver to remove the grommet. Use care not to damage the main control bore.**

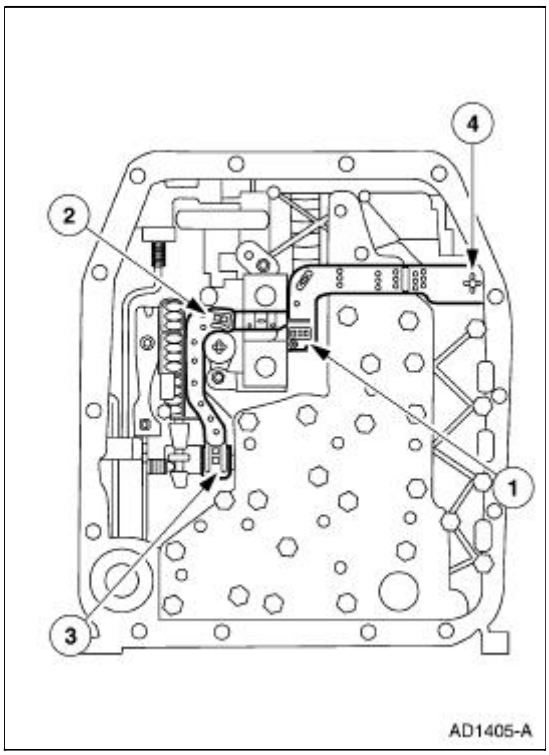
   NOTE: If transmission is being repaired for a contamination-related failure, use a new filter and seal. The filter may be reused if no excessive contamination is present.

   Remove the fluid filter and grommet.

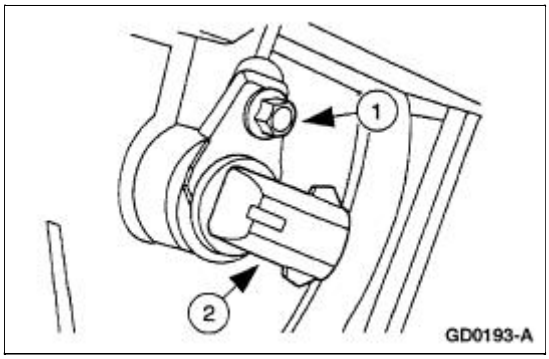


7. **CAUTION: Do not pull on the molded lead frame. This may cause damage to the connector ends. Carefully pry up on the locking tabs to disconnect the solenoids. Disconnect the molded lead frame from the solenoids.**

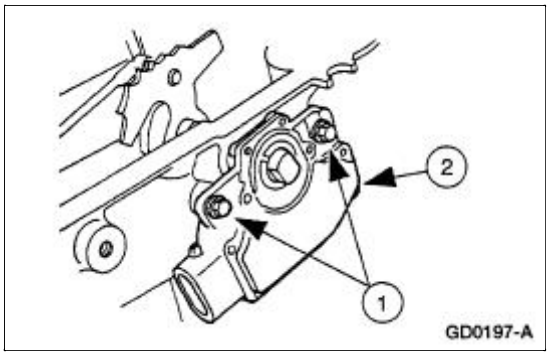
   Disconnect the molded lead frame from the solenoids.
   1. Disconnect the shift solenoid SSA and SSB.
   2. Disconnect the torque converter clutch (TCC).
   3. Disconnect the electronic pressure control (EPC) solenoid.
   4. Disconnect the bulkhead inter-connector.



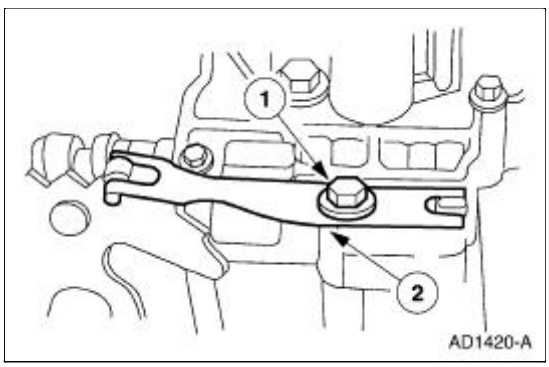
8. Remove the output shaft speed (OSS) sensor.
   1. Remove the bolt.
   2. Remove the OSS sensor.



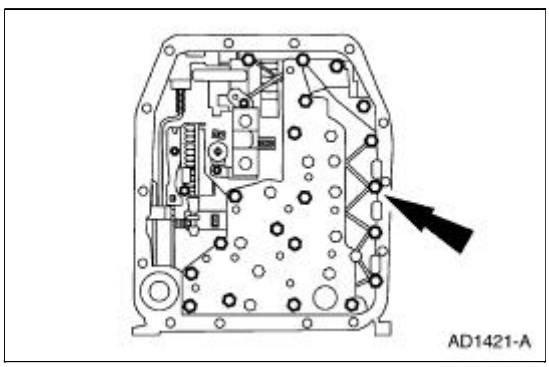
9. Remove the digital transmission range (TR) sensor.
    1. Remove the bolts.
    2. Remove the digital TR sensor.



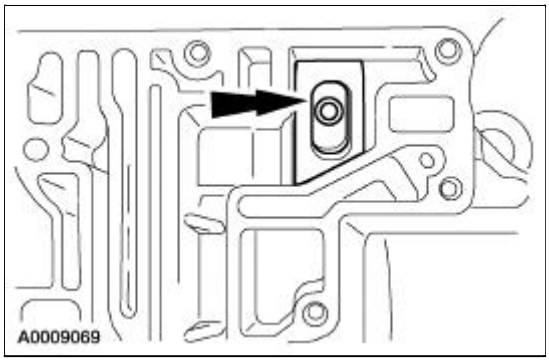
10. Remove the manual control valve detent lever spring.
    1. Remove the bolt.
    2. Remove the manual control valve detent lever spring.



11. Remove the 24 main control valve body bolts and the main control valve body.

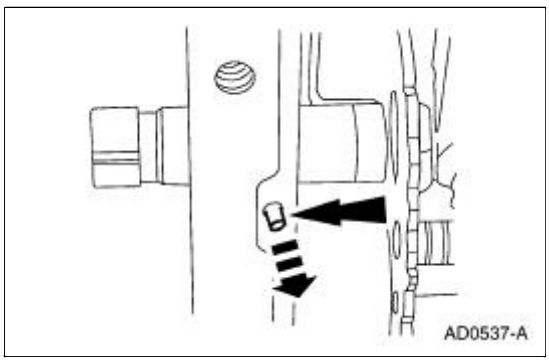


12. Remove and discard the pump outlet screen.

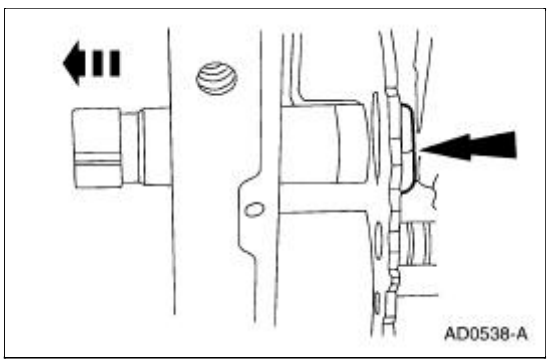


13. **NOTE:** Use a shop cloth to protect the transmission case surface.

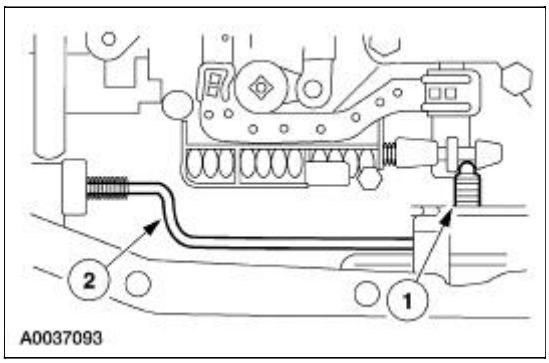
    Remove the manual lever shaft retaining pin.



14. Remove the manual lever shaft inner nut.
    - Slide the manual control lever shaft out of the case while removing the inner nut.

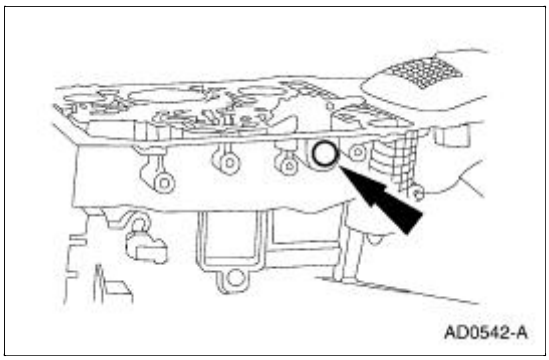


15. Remove the parking lever actuating rod.
    1. Remove the manual valve detent.
    2. Remove the parking lever actuating rod.

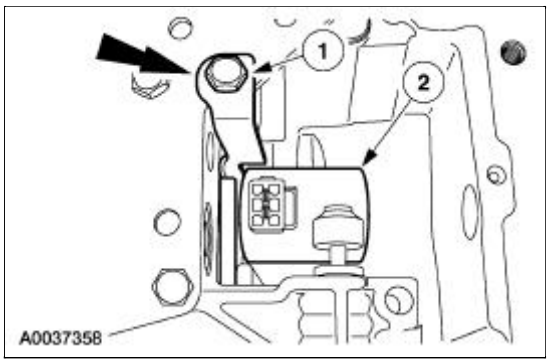


16. **CAUTION: Use care not to damage the manual control lever shaft bore. If the bore is damaged the new seal may leak.**

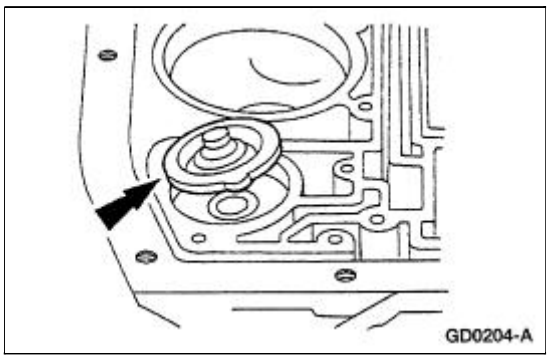
    Remove the manual control lever shaft seal.



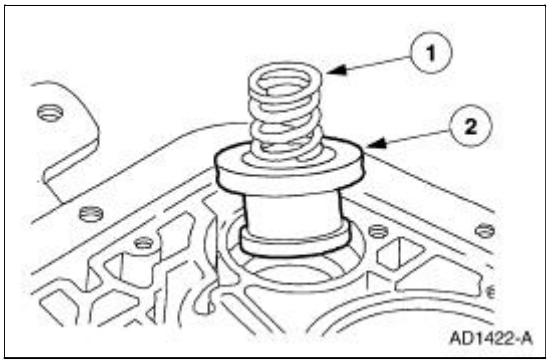
17. Remove the EPC solenoid.
    1. Remove the bolt and EPC solenoid bracket.
    2. Remove the EPC solenoid.



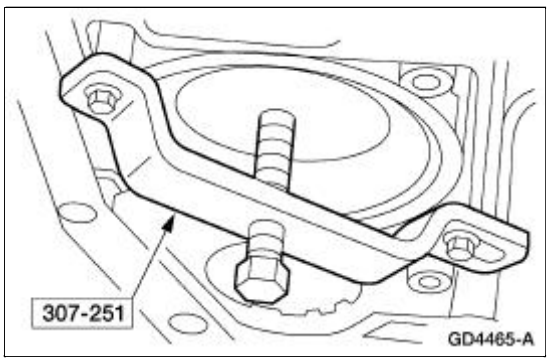
18. Remove the 2-3 accumulator spring retainer.



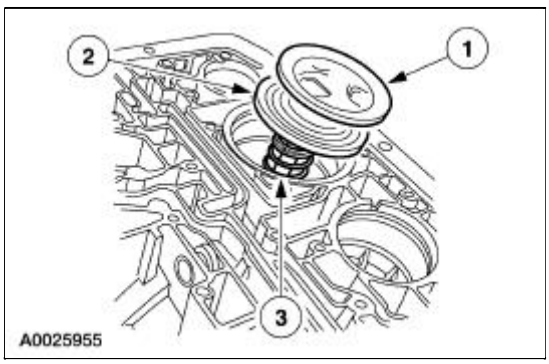
19. Remove the 2-3 accumulator piston.
    1. Remove the 2-3 accumulator spring.
    2. Remove the 2-3 accumulator piston.



20. Using the special tool, remove the reverse band servo retaining ring.

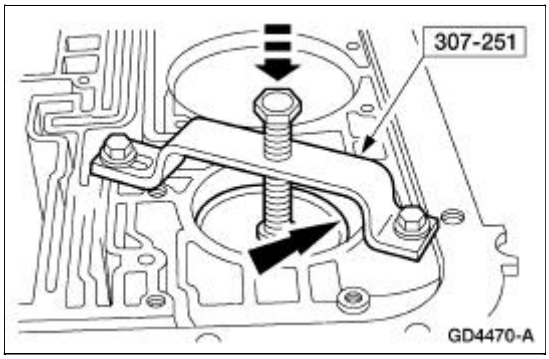


21. Remove the reverse servo assembly.
    1. Remove the reverse band servo cover.
    2. Remove the reverse band servo piston and rod.
    3. Remove the reverse band servo spring.

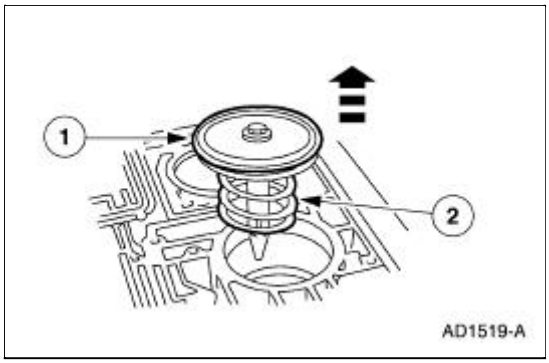


22. **NOTE:** If tool is not available, extreme care must be taken. Spring pressure will force overdrive servo piston assembly out of case. Case bore damage may result from trying to pry on internal retaining ring.

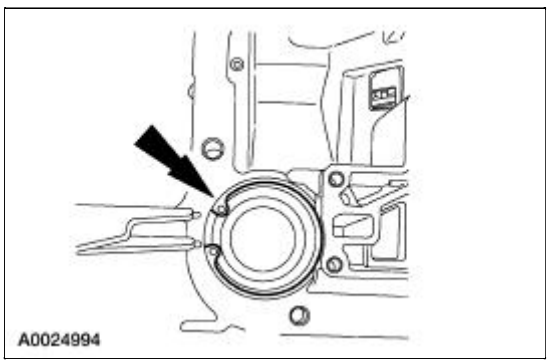
    Using the special tool, compress the piston spring, then remove the overdrive servo piston retainer.



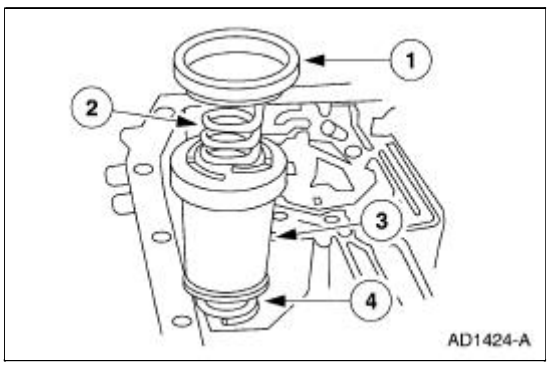
23. Remove the overdrive servo piston.
    1. Remove the overdrive servo piston.
    2. Remove the overdrive servo piston return spring.



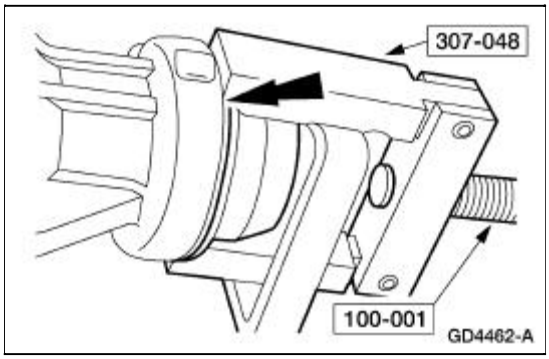
24. Compress the 1-2 accumulator cover and remove the retaining ring.



25. Remove the 1-2 accumulator upper spring.
    1. Remove the 1-2 accumulator spring cover.
    2. Remove the 1-2 accumulator lower spring.
    3. Remove the 1-2 accumulator.
    4. Remove the 1-2 accumulator upper spring.

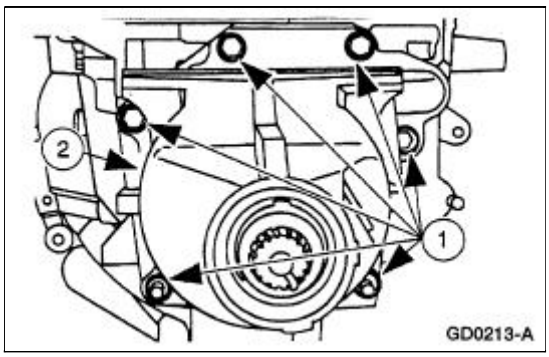


26. Using the special tools, remove the extension housing seal.

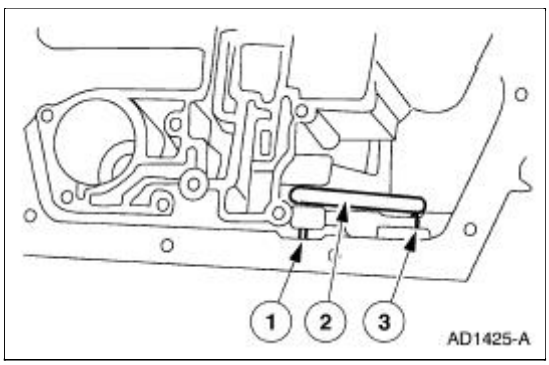


27. **NOTE:** These bolts have been coated with a sealant. High break torque may be required to remove these bolts.

    Remove the extension housing.
    1. Remove the four bolts and two nuts.
    2. Remove the extension housing and the extension housing gasket.



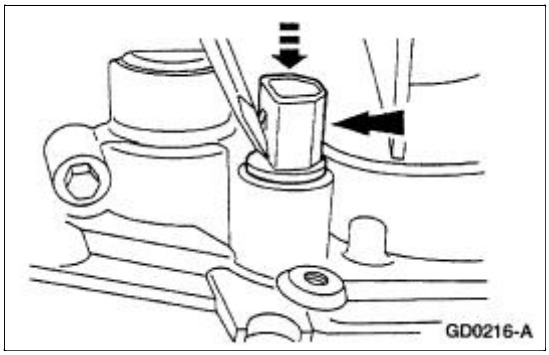
28. Remove the parking pawl.
    1. Remove the parking pawl shaft.
    2. Remove the parking pawl return spring.
    3. Remove the parking pawl.



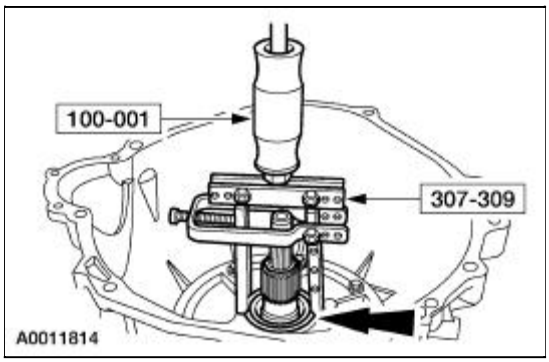
29. Rotate the transmission to the vertical position with the output shaft towards the floor.

30. **CAUTION: Extreme care must be taken during transmission connector removal. Do not use a hammer on the connector body.**

    Place a screwdriver on the flat portion of the connector and push the connector out through the bottom of the case.

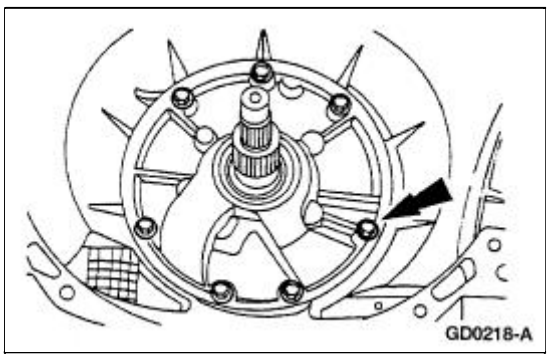


31. Using the special tools, remove the front pump seal.

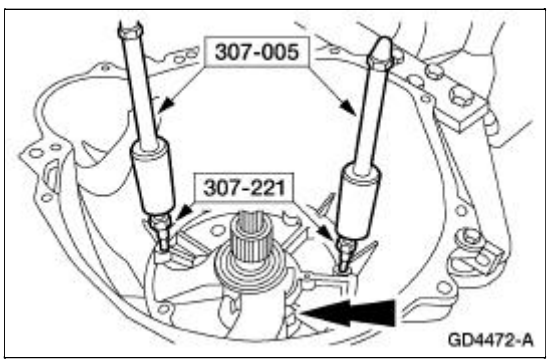


32. **NOTE:** These bolts have been coated with sealant. High break torque may be required to remove the bolts.

    Remove the bolts.

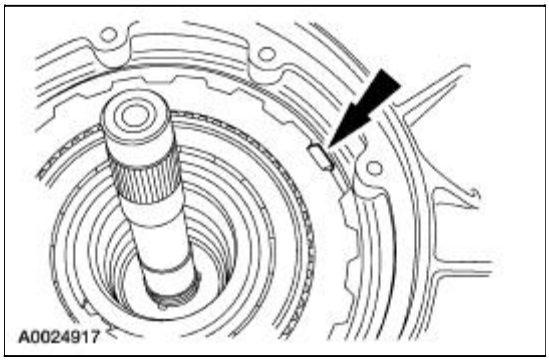


33. Using the special tools, remove the front pump support.



34. Remove and discard the pump gasket.

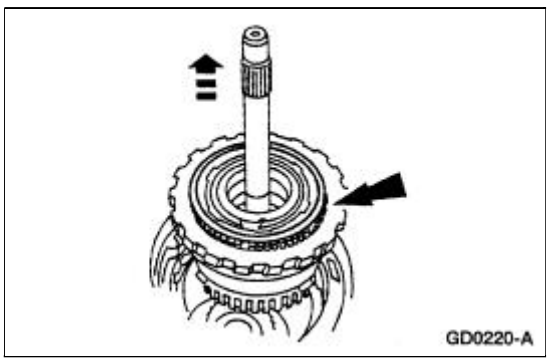
35. Remove the intermediate anti-rattle clip, if equipped.



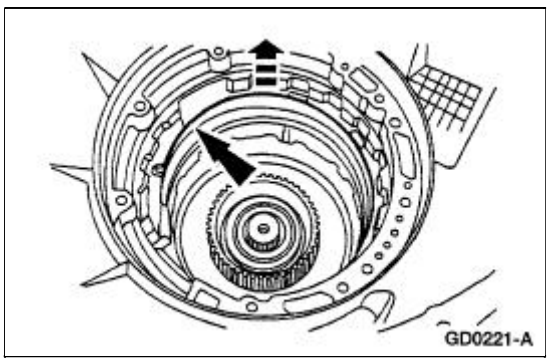
36. **CAUTION: Remove the assembly carefully to prevent damage to the overdrive band friction material by the reverse clutch drive lugs.**

    Remove the following components as an assembly:

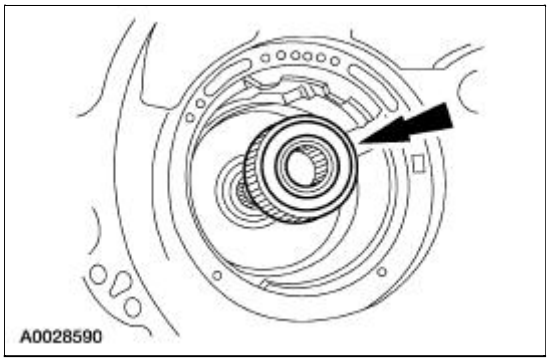
    - Intermediate clutch pack.
    - Intermediate one-way clutch.
    - Reverse clutch.
    - Forward clutch assembly.



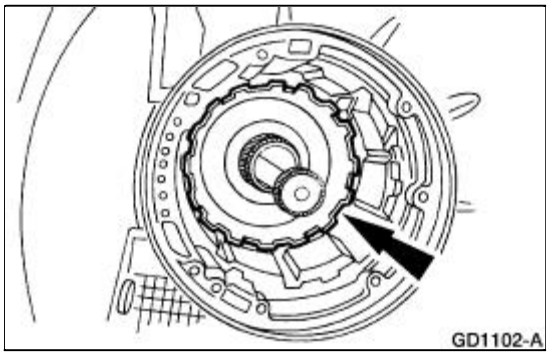
37. Disengage and remove the overdrive band.



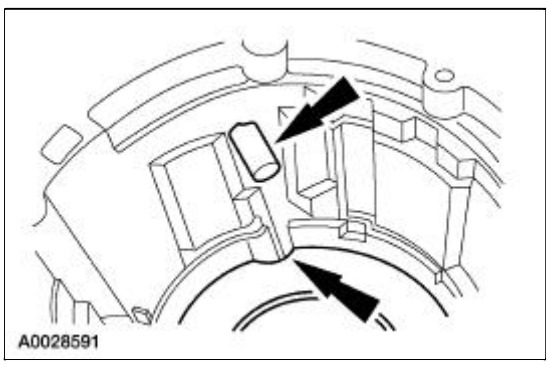
38. Remove the forward clutch hub and the No. 3 forward clutch hub front bearing.



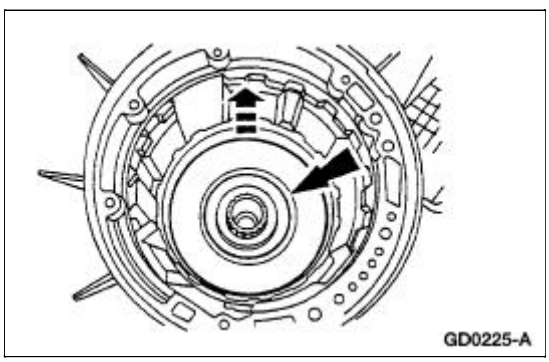
39. Remove the intermediate stub shaft.



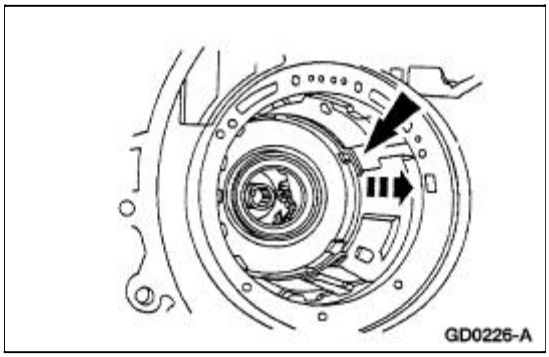
40. Align the reverse sun shell with the overdrive band anchor pin for removal.



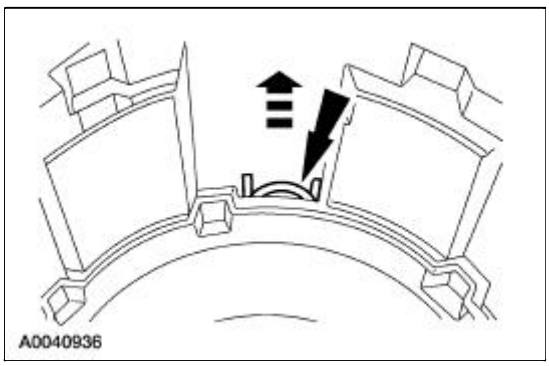
41. Remove the following components as an assembly:
    - Forward clutch sun gear.
    - No. 5 forward clutch sun gear bearing.
    - Reverse clutch sun gear.
    - No. 4 forward clutch hub bearing.



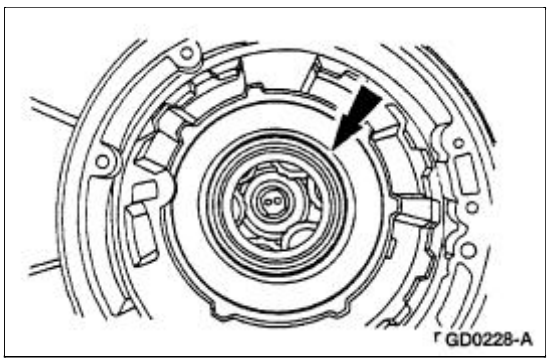
42. Remove the center support retaining ring and note location for assembly.



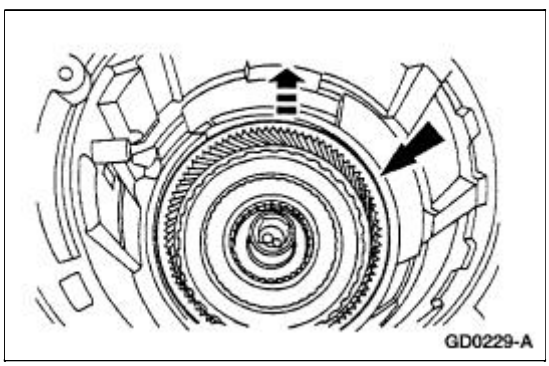
43. Remove the case to planet support spring.



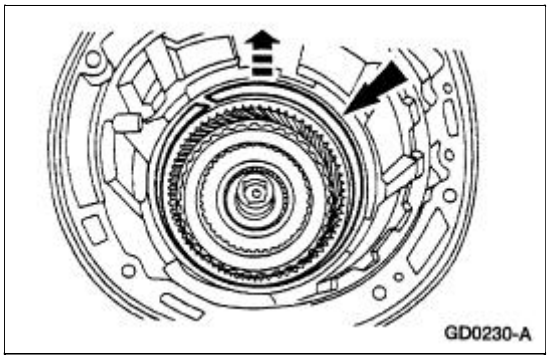
44. Remove the planetary gear support and planetary as an assembly.



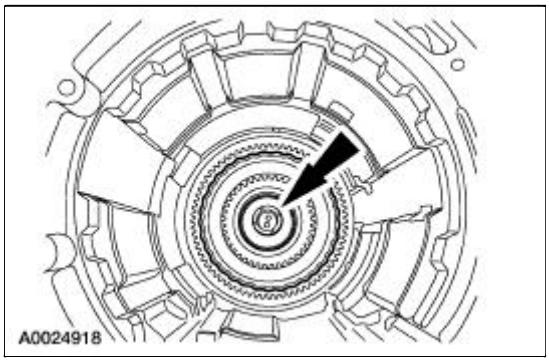
45. Remove the reverse clutch band.



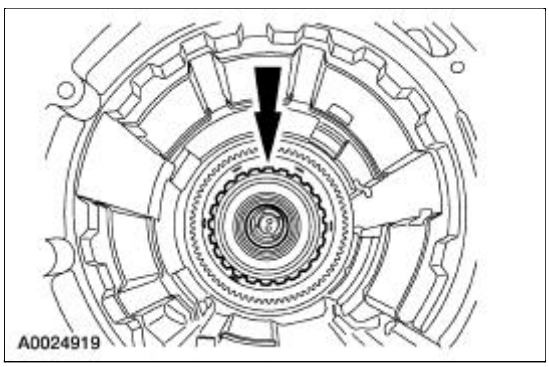
46. Remove the retaining ring.



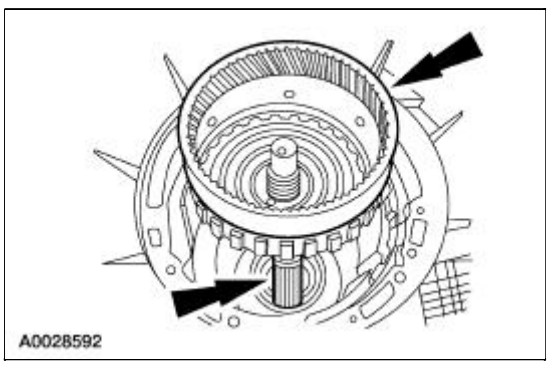
47. Remove the direct clutch pack.



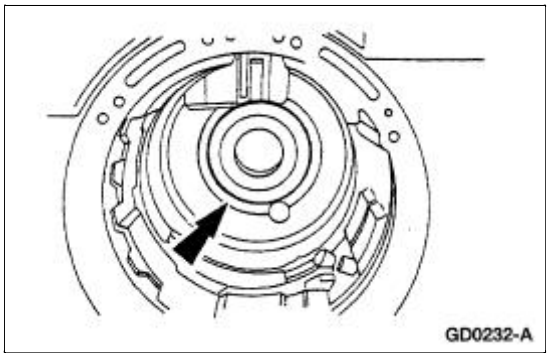
48. Remove the No. 8 bearing.



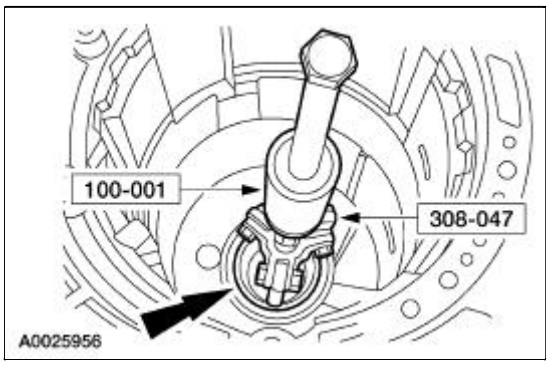
49. Remove the output shaft, output shaft ring gear assembly and direct clutch.



50. Remove the No. 9 case rear bearing.



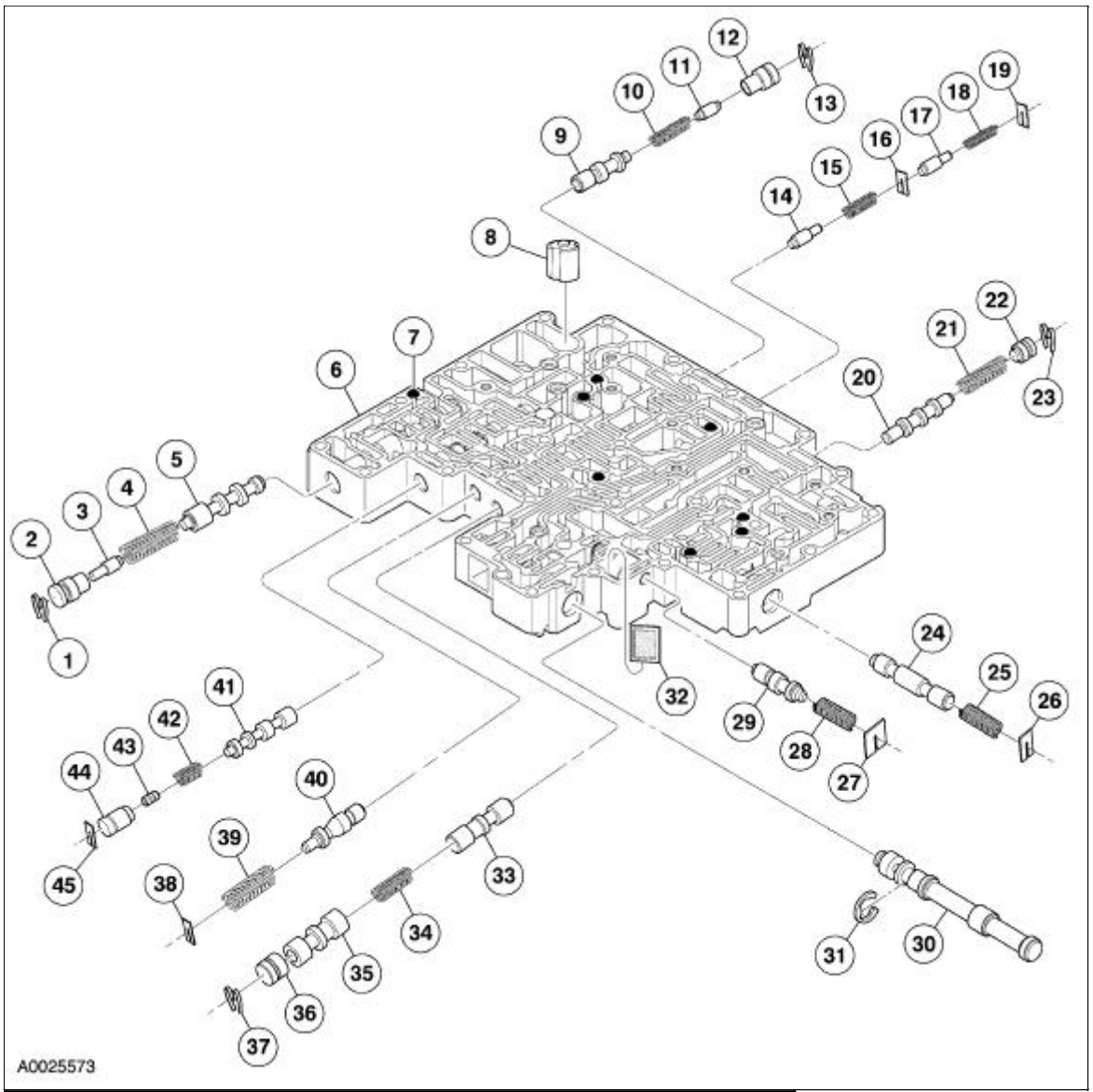
51. Inspect and if necessary, use the special tools to remove the rear case bushing.



Main Control Valve Body

Disassembly

Main Control Valve Body — Disassembled View

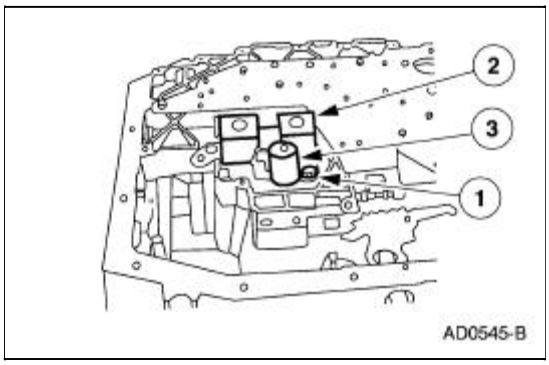


Item	Part Number	Description
1	—	Valve plug retainer (part of 7A100)
2	—	Main pressure booster valve sleeve (part of 7A100)
3	—	Main pressure booster valve (part of 7A100)
4	—	Main pressure regulator valve spring (part of 7A100)
5	—	Main regulator valve (part of 7A100)

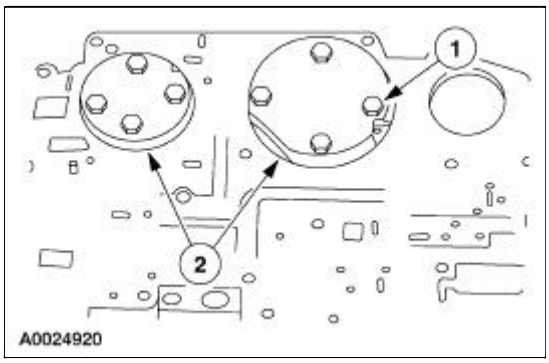
6	7A100	Main control valve body assembly
7	7E195	Check ball (8 req'd)
8	7H171	Converter drain back valve
9	—	Pressure regulator valve (part of 7A100)
10	—	Pressure regulator valve spring (part of 7A100)
11	—	Regulator boost plunger (part of 7A100)
12	—	Regulator boost sleeve (part of 7A100)
13	—	Valve retainer (part of 7A100)
14	—	Capacity modulator valve (part of 7A100)
15	—	Capacity modulator valve spring (part of 7A100)
16	—	Spring retaining plate (part of 7A100)
17	—	Capacity modulator valve (part of 7A100)
18	—	Capacity modulator valve spring (part of 7A100)
19	—	Spring retaining plate (part of 7A100)
20	—	3-4 shift valve (part of 7A100)
21	—	3-4 shift valve spring (part of 7A100)
22	—	Valve retainer plug (part of 7A100)
23	—	Valve plug retainer (part of 7A100)
24	—	2-3 backout valve (part of 7A100)
25	—	2-3 backout valve spring (part of 7A100)
26	—	Spring retaining plate (part of 7A100)
27	—	Spring retaining plate (part of 7A100)
28	—	Pressure regulator valve spring (part of 7A100)
29	—	Pressure regulator valve (part of 7A100)
30	—	Control manual valve (part of 7A100)
31	—	Retaining ring (part of 7A100)
32	—	Solenoid screen
33	—	1-2 shift valve (part of 7A100)
34	—	2-3 shift valve spring (part of 7A100)
35	—	2-3 valve (part of 7A100)
36	—	Valve retaining plug (part of 7A100)
37	—	Valve plug retainer (part of 7A100)
38	—	Spring retaining plate (part of 7A100)
39	—	Pressure regulator valve spring (part of 7A100)
40	—	Pressure regulator valve (part of 7A100)
41	—	Bypass clutch control valve (part of 7A100)
42	—	Bypass clutch control valve spring (part of 7A100)
43	—	Bypass clutch control valve plunger (part of 7A100)
44	—	Bypass clutch control plunger sleeve (part of 7A100)

45	—	Control valve plate (part of 7A100)

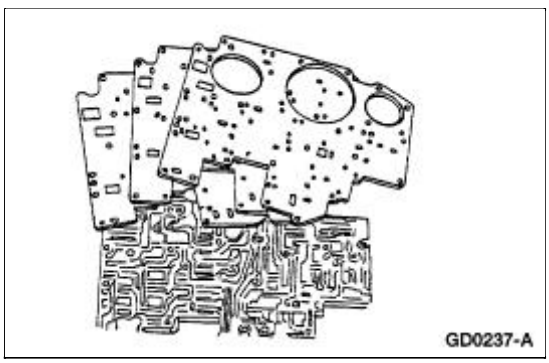
1. Remove the torque converter clutch (TCC) solenoid and the shift solenoid.
    1. Remove the bolt.
    2. Remove the shift solenoid.
    3. Remove the TCC solenoid.



2. Remove the two reinforcement plates.
    1. Remove the bolts.
    2. Remove the plates.

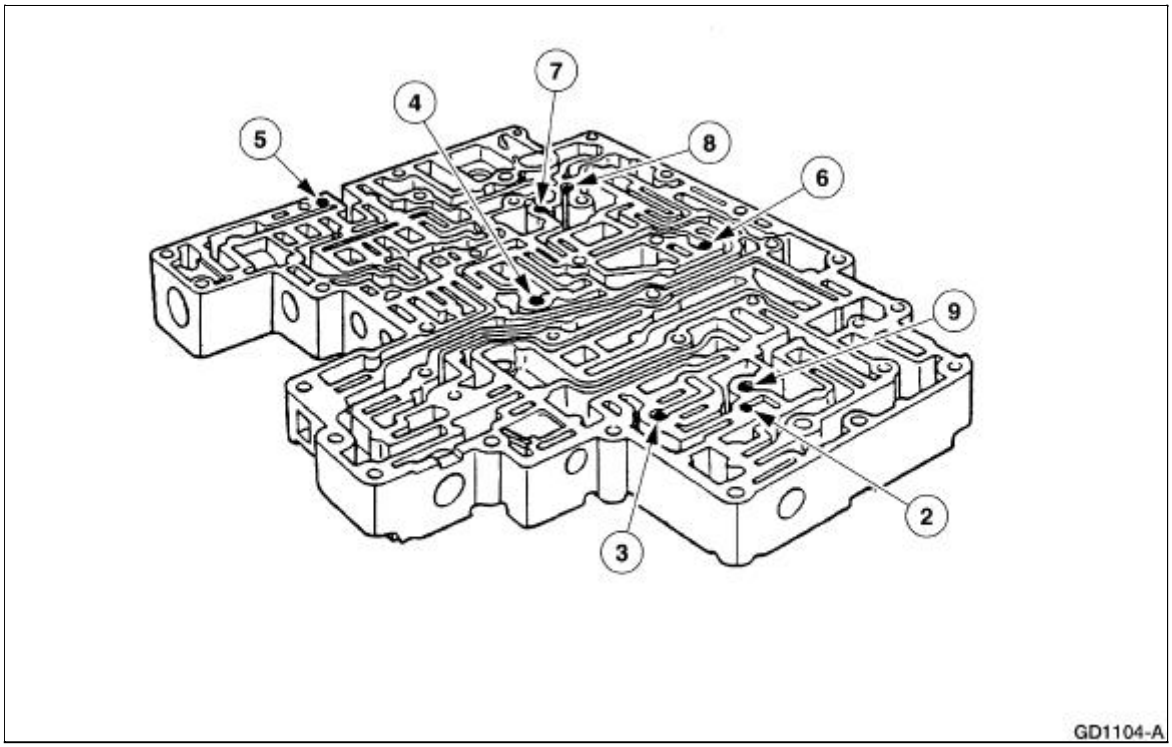


3. Remove the separator plate and discard the gaskets.

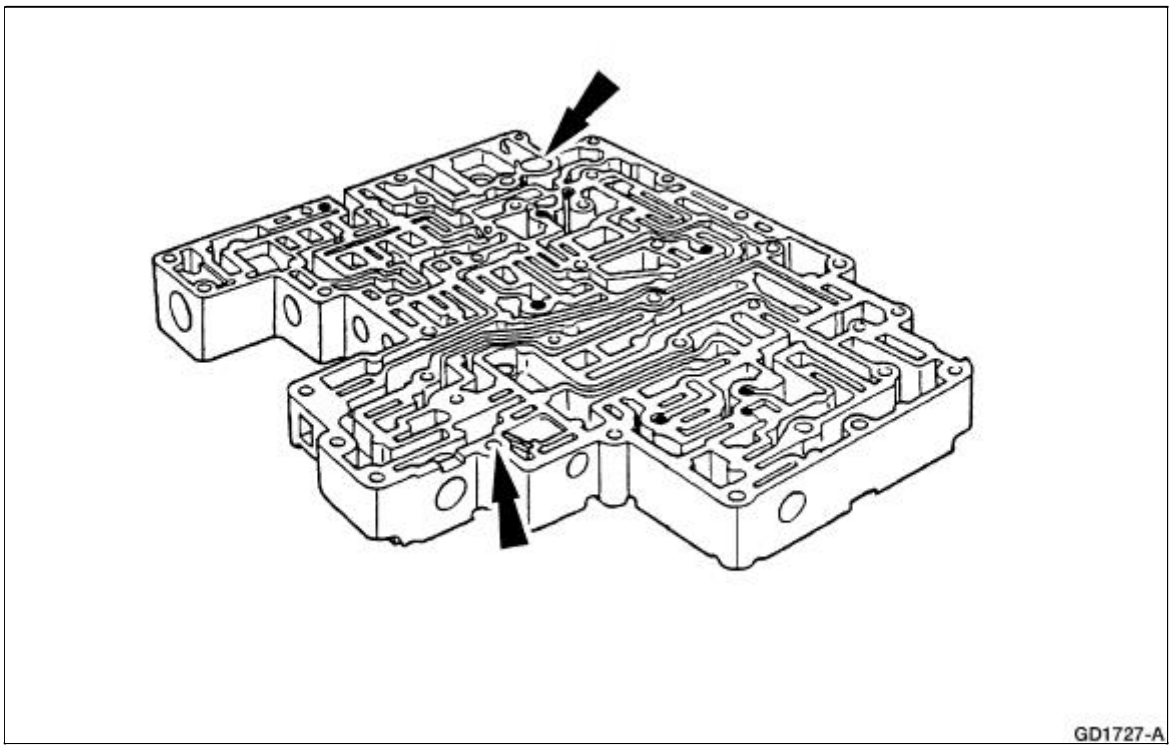


4. **NOTE:** Note the location of the eight coasting booster valve shuttle balls for assembly.

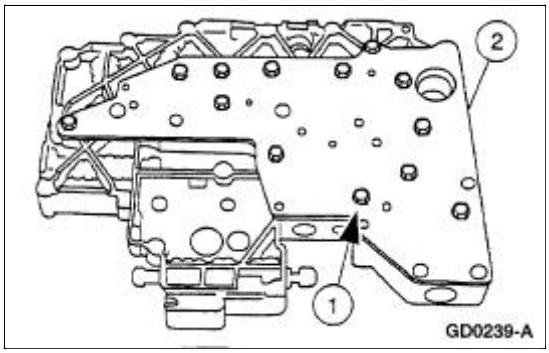
   Remove the eight coasting booster valve shuttle balls.



5. Remove the converter drain back valve and solenoid pressure supply screen.



6. Remove the main control valve body cover plate.
    1. Remove the 13 bolts.
    2. Remove the valve body cover plate and gasket.



Assembly

1. **CAUTION: Before beginning assembly, carry out and inspect the following:**

   When building up subassemblies and assembling the transmission, ALWAYS use new gaskets and seals.

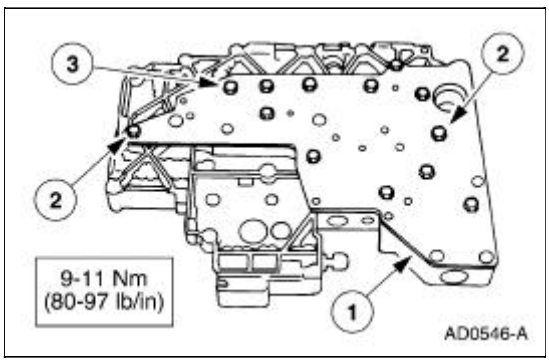
   All fasteners must be tightened to the torque specification indicated. In addition to appearing in the section, the necessary torques can be found in the General Specifications Chart.

   When building up subassemblies, each component part should be lubricated with clean transmission fluid. It is also good practice to lubricate the subassemblies as they are installed in the case.

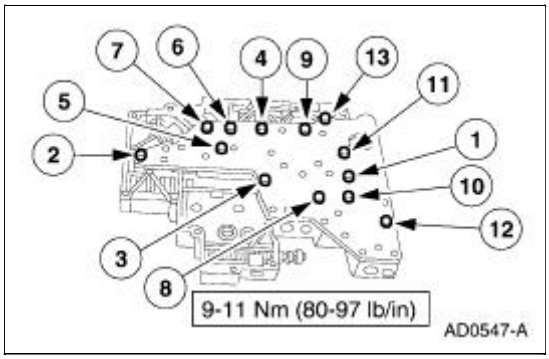
   Needle bearings, thrust washers and seals should be lightly coated with petroleum jelly during subassembly buildup or transmission assembly.

   Many components and surfaces in the transmission are precision machined. Careful handling during disassembly, cleaning, inspection and assembly can prevent unnecessary damage to machined surfaces.

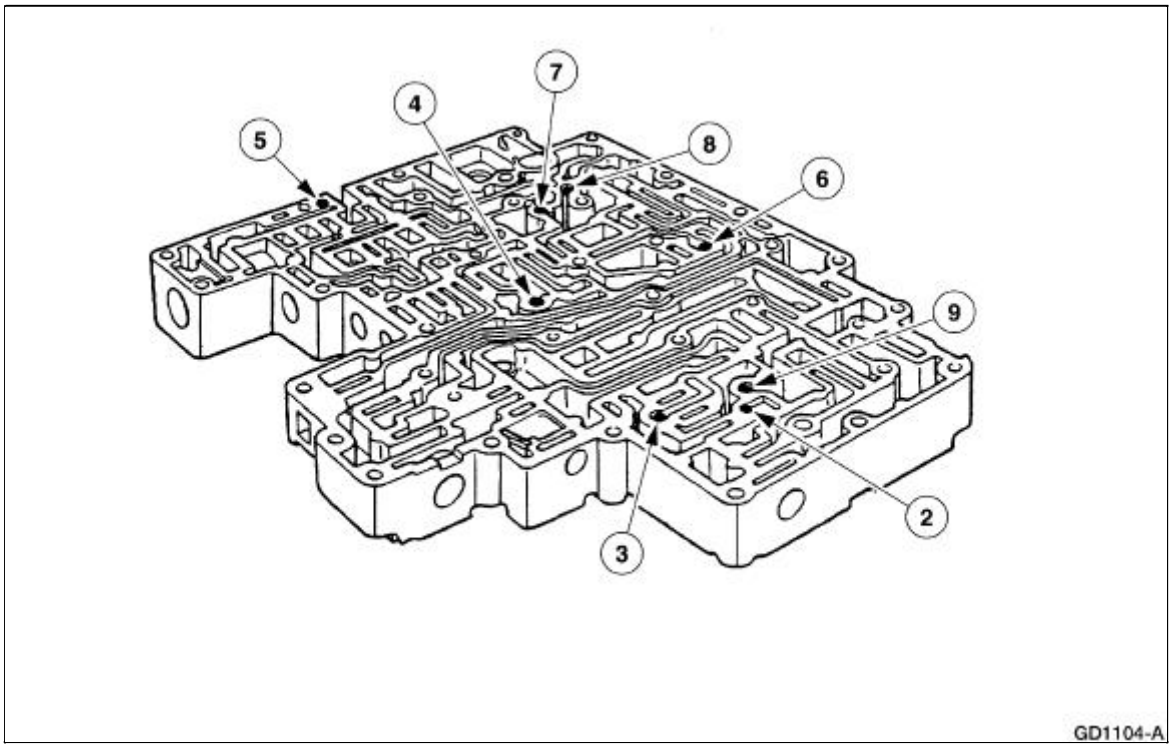
   Install the valve body cover plate.
   1. Position the valve body cover plate gasket and cover plate.
   2. Install the two guide pin bolts.
   3. Install the bolts.



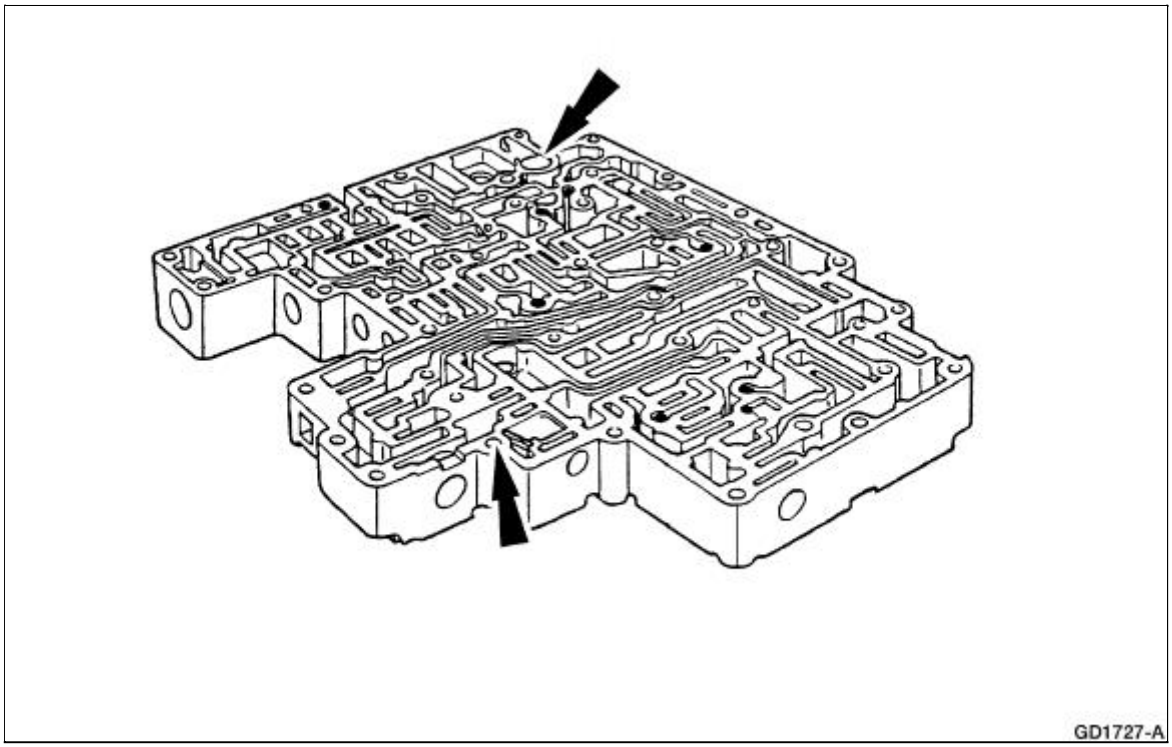
2. Tighten the bolts in the sequence shown.



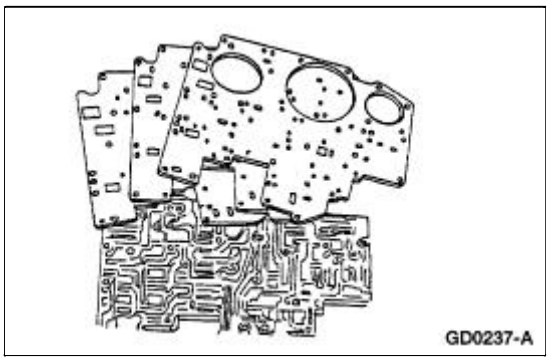
3. Install the eight coasting booster valve shuttle balls.



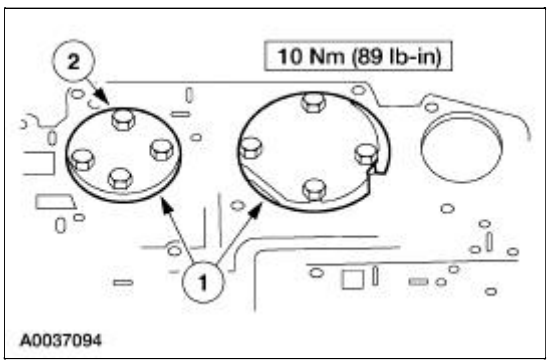
4. Install the converter drain back valve and solenoid pressure supply screen.



5. Install the separator plate and gaskets.



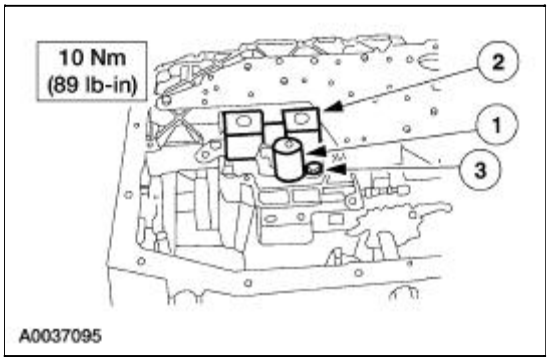
6. Install the two reinforcement plates.
    1. Position the plates.
    2. Install the bolts.



7. **NOTE:** Inspect the shift solenoid O-rings and TCC solenoid O-rings for damage.

    Install the shift solenoid.
    1. Position the TCC solenoid.
    2. Position the shift solenoid.

3. Install the bolt.

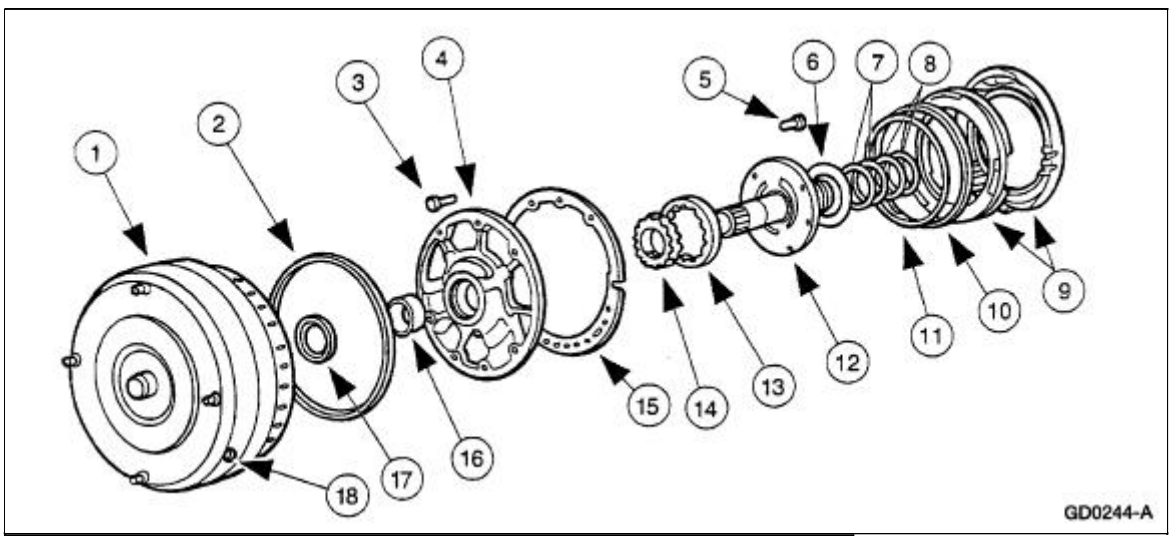


Pump and Intermediate Clutch Piston

Special Tool(s)

ST1189-A	Installer, Front Pump Fluid Seal 307-014 (T63L-77837-A)
ST1914-A	Protector, Piston Seal 307-339 (T95L-77005-A)

Pump and Intermediate Clutch Piston — Disassembled View

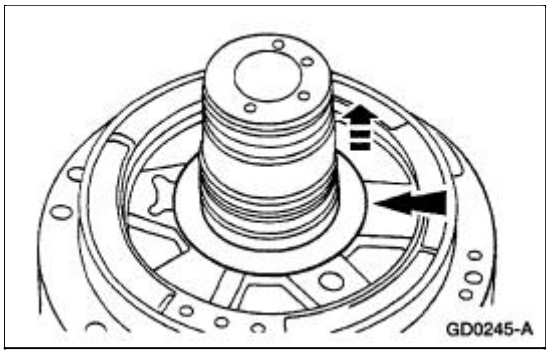


Item	Part Number	Description
1	7902	Torque converter
2	7A248	Front pump O-ring
3	N605789-S101	Bolt
4	—	Pump body assembly
5	N605787-S1000	Front pump support bolt
6	7D014	No. 1 pump support thrust washer
7	7D020	Reverse clutch cylinder seal
8	7D019	Forward clutch cylinder seal
9	7E005	Intermediate clutch piston
10	7F224	Intermediate clutch piston outer seal

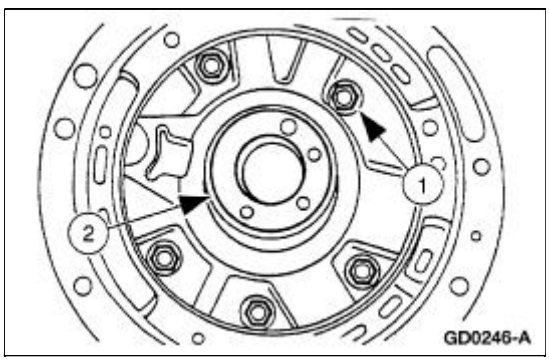
11	7F225	Intermediate clutch piston inner seal
12	7A108	Pump support
13	—	Pump outer gerotor gear
14	—	Pump inner gerotor gear
15	7A136	Pump gasket
16	—	Pump bushing
17	7A248	Pump inner seal
18	391855-S100	Converter drain plug

Disassembly

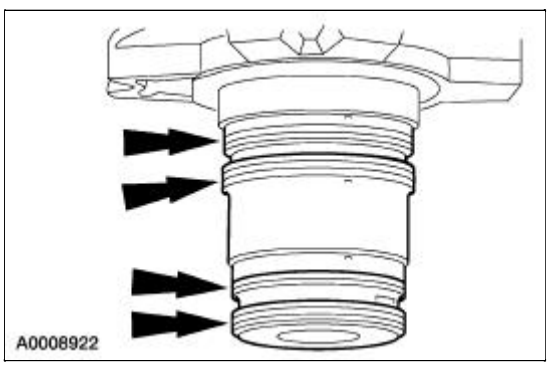
1. Remove the No. 1 selective pump support thrust washer.



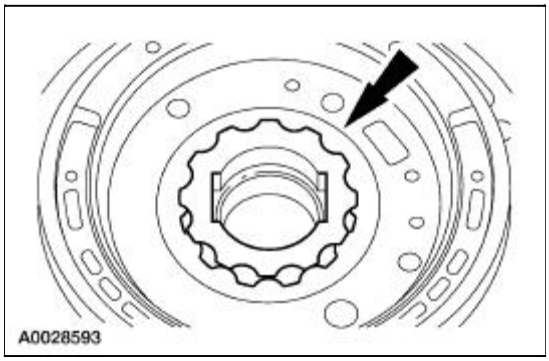
2. Remove the front pump support.
    1. Remove the bolts.
    2. Remove the front pump support.



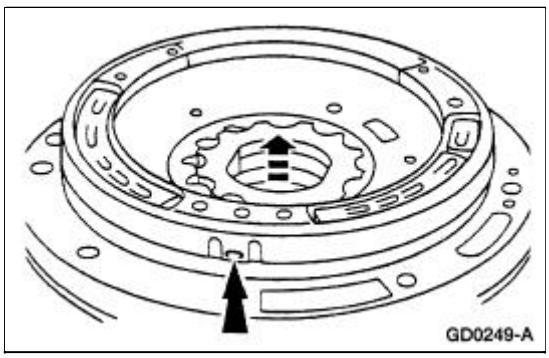
3. Remove the seal rings.



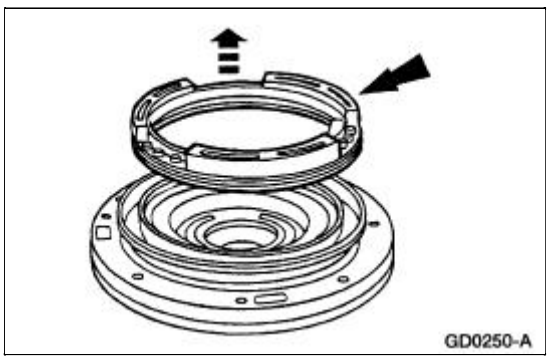
4. Remove the inner and outer pump gerotor gears.



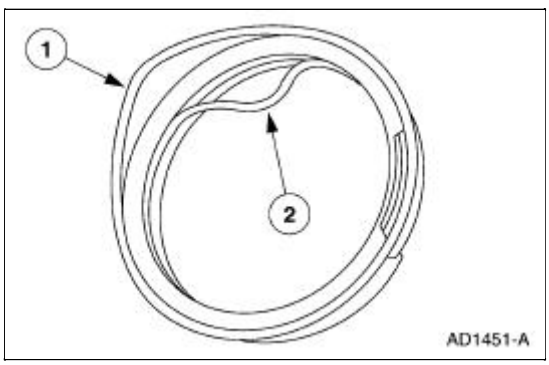
5. Carefully pry spring retainer tabs and remove the spring retainer assembly.



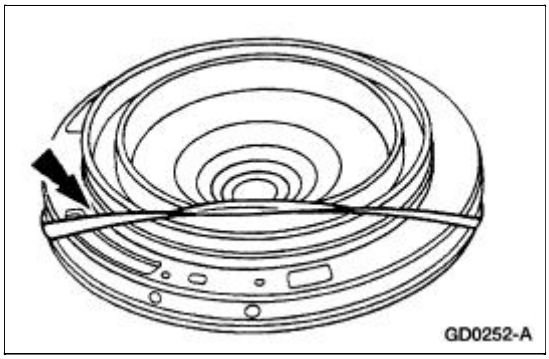
6. Remove the intermediate clutch piston.



7. Remove the clutch piston seals.
    1. Remove the intermediate clutch piston outer seal.
    2. Remove the intermediate clutch piston inner seal.

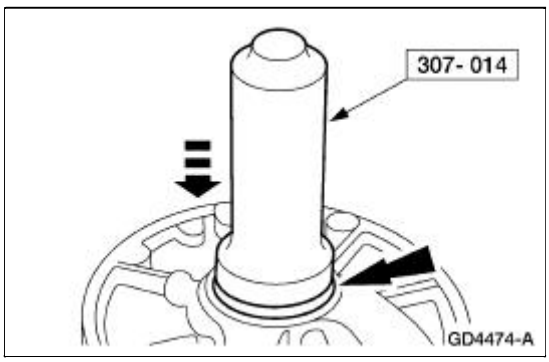


8. Remove and discard the front pump seal.

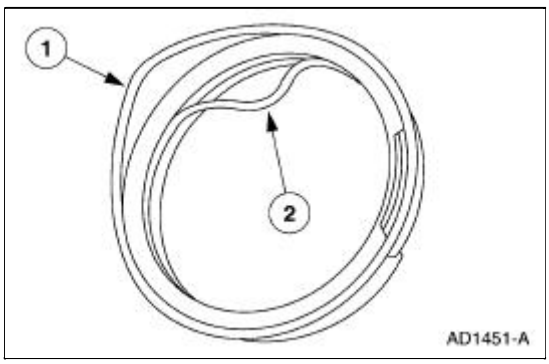


Assembly

1. Using the special tool, install the front pump seal assembly.

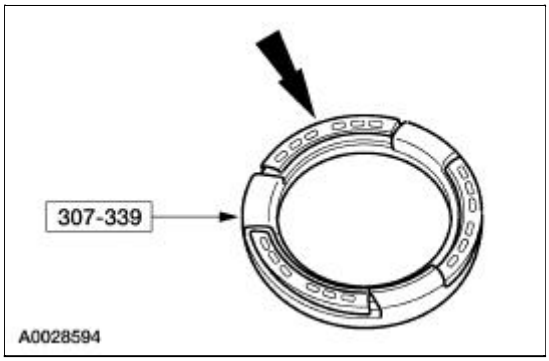


2. Install the clutch piston seals.
    1. Install the intermediate clutch piston outer seal.
    2. Install the intermediate clutch piston inner seal.

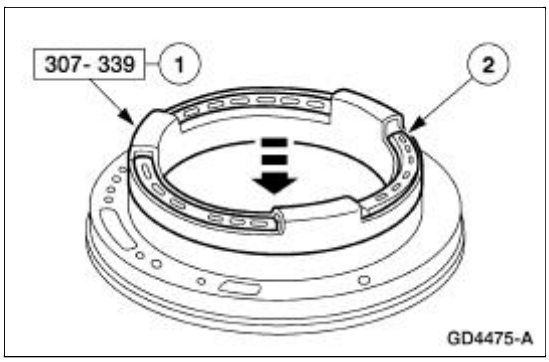


3. **NOTE:** Coat the intermediate clutch piston outer seal, inner seal and pump body with petroleum jelly.

    Install the intermediate clutch piston into the special tool.



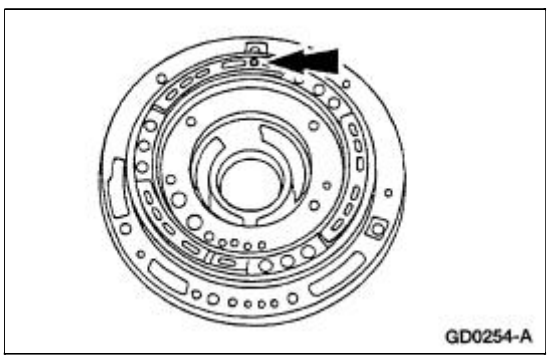
4. Using the special tool, install the intermediate clutch piston.
    1. Position the intermediate clutch piston and the special tool onto the pump body.
    2. Push the intermediate clutch piston to the bottom of the pump body bore, exerting even pressure and remove the special tool.



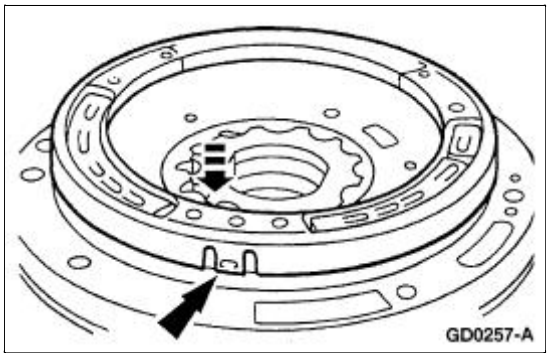
5. **CAUTION: The piston bleed hole must be located at 12 o'clock position (towards the top of the transmission). Shift problems may occur if installed incorrectly.**

    NOTE: The piston bleed hole is the only round hole in the pump body.

    Locate the piston bleed hole.

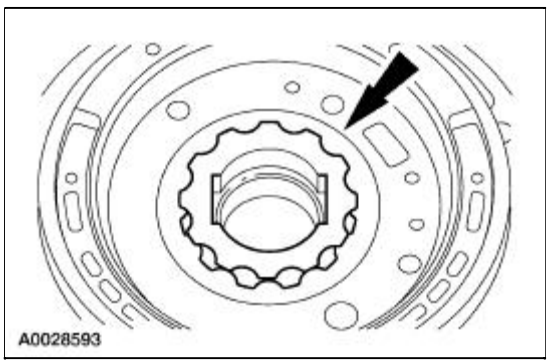


6. Install by snapping the spring retainer assembly on pump body.



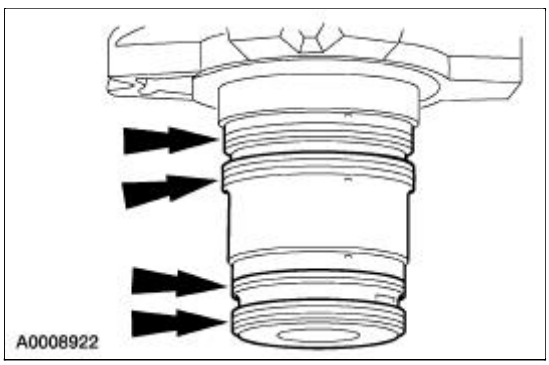
7. **NOTE:** The flats on the inner fluid pump gear have steps that must face the pump body or damage will result.

   Install the inner and outer fluid pump gerotor gears.

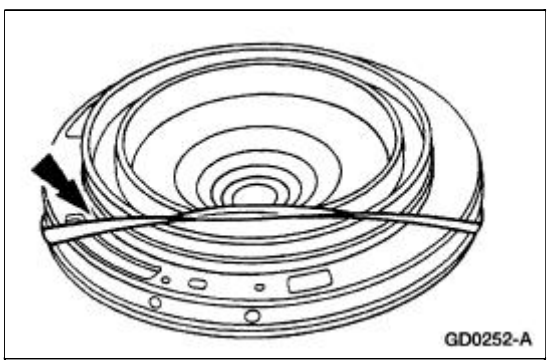


8. **NOTE:** The reverse clutch cylinder seal rings are larger than the forward clutch cylinder seals.

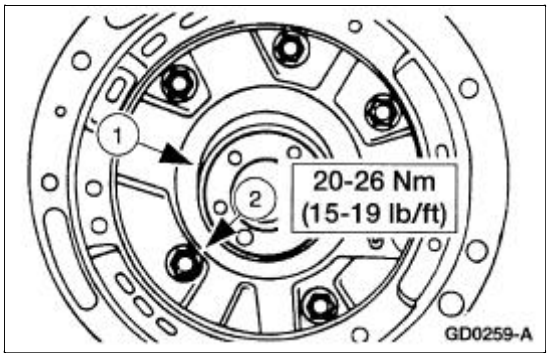
   Install the seal rings.



9. Install a new front pump seal.

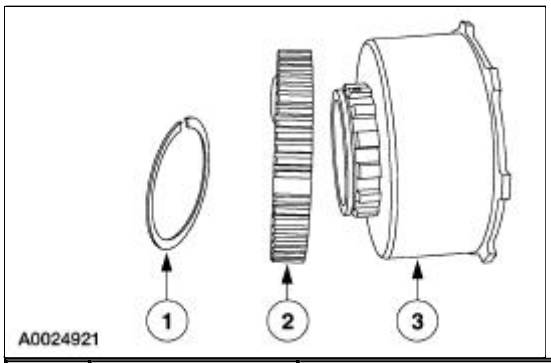


10. Assemble the front pump.
    1. Position the pump support to the pump body assembly.
    2. Install the bolts.



Intermediate One-Way Clutch

Intermediate Clutch Cylinder Disassembled View

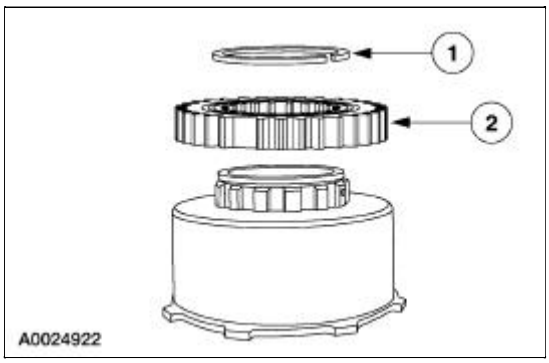


Item	Part Number	Description
1	391267-S	Retaining ring
2	7A089	Intermediate one-way clutch assembly
3	7D044	Reverse clutch drum

Disassembly

1. **NOTE:** One tab that locks the reverse clutch drum into the reverse sun shell may be removed. This is done for balancing purposes.

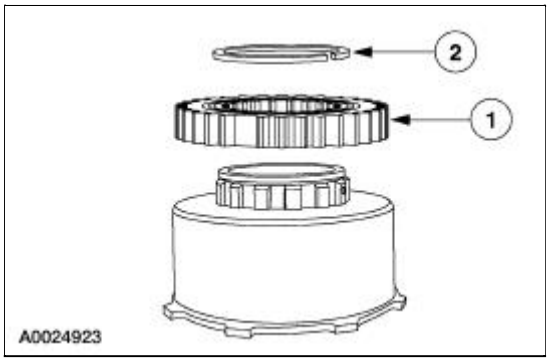
   Remove the intermediate one-way clutch.
   1. Remove the snap ring.
   2. Remove the intermediate one-way clutch.



Assembly

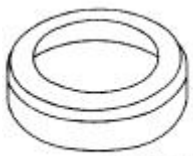
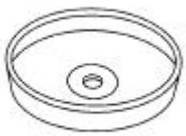
1. **NOTE:** The intermediate one-way clutch must rotate counterclockwise when installed on the reverse clutch drum and will make a ratchet sound.

   Install the intermediate one-way clutch.
   1. Install the intermediate one-way clutch.
   2. Install the snap ring.


2
1
A0024923

Reverse Clutch

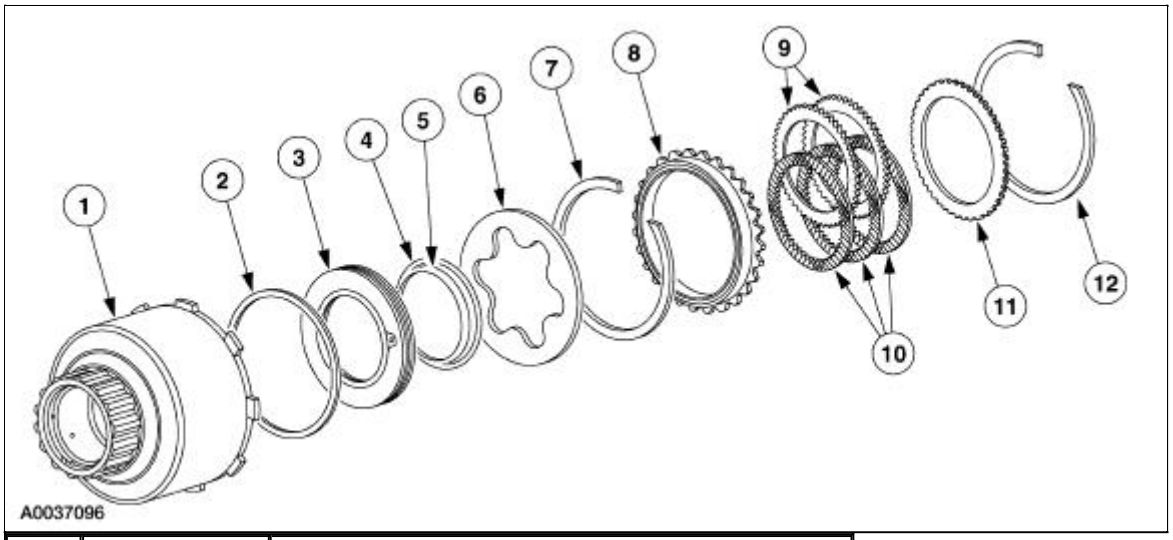
Special Tool(s)

ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
ST1190-A	Compressor, Clutch Spring 307-015 (T65L-77515-A)
ST1206-A	Protector, Transmission Reverse Clutch Outer Fluid Seal 307-424
 ST1207-A	Protector, Transmission Reverse Clutch Inner Fluid Seal 307-425
 ST1198-B	Compressor, Clutch Spring 307-086 (T80L-77405-A)

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

Reverse Clutch Disassembled View



Item	Part Number	Description
1	7D044	Reverse clutch drum
2	7D403	Reverse clutch piston outer seal
3	7D402	Reverse clutch piston
4	7D404	Reverse clutch piston inner seal
5	7D256	Reverse clutch piston spring pressure ring
6	7B070	Reverse clutch piston spring
7	7A577	Reverse clutch piston spring ring
8	7B066	Reverse clutch front pressure plate
9	7B442	Reverse clutch external spline plates (steel)
10	7B164	Reverse clutch internal spline plates (friction)
11	7B066	Reverse clutch rear pressure plate
12	7D483	Reverse clutch retaining ring (select fit)

Disassembly

1. Inspect the clutch cylinder thrust surfaces, piston bore and clutch plate serrations for scores or burrs. Minor scores or burrs may be removed with a crocus cloth. Install a new clutch cylinder if badly scored or damaged.

2. Check fluid passage in the clutch cylinder for obstructions. Clean out all fluid passages. Inspect the clutch piston for scores and install new if necessary. Inspect check balls for freedom of movement and correct seating.

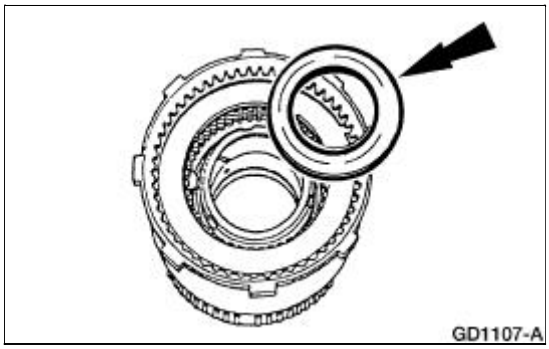
3. Check clutch release spring for distortion and cracks. Install a new spring (including the wave spring) if distorted or cracked.

4. Inspect the composition clutch plates, steel clutch plates and clutch pressure plate for worn or scored bearing surfaces. Install new parts if they are deeply scored or burred.

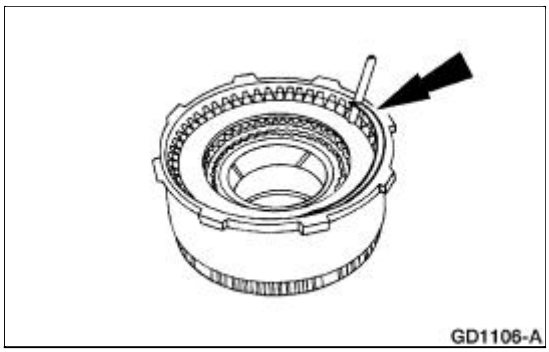
5. Check the clutch plates for flatness and fit on clutch hub serrations. Discard any plate that does not slide freely on serrations or that is not flat.

6. Check clutch hub thrust surfaces for scores and clutch hub splines for wear.

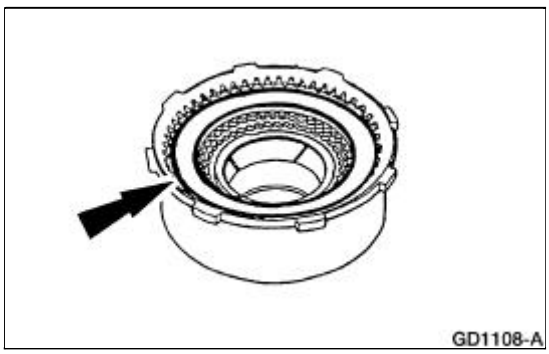
7. Remove the No. 2 forward clutch bearing.



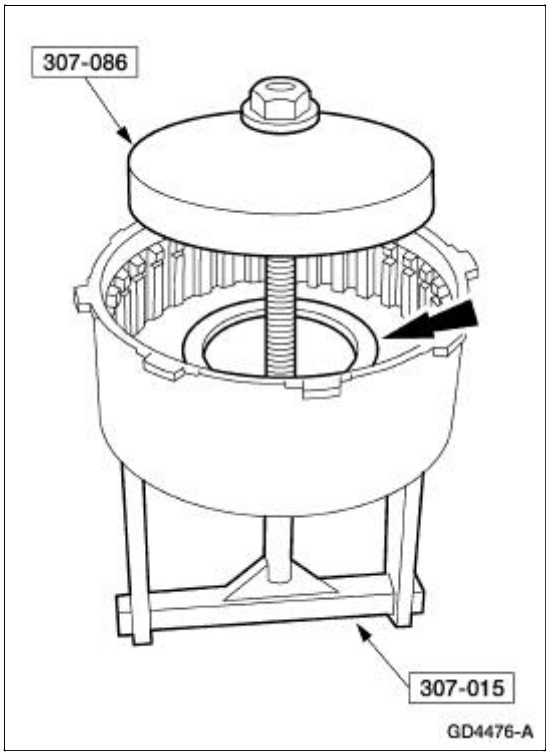
8. Remove the reverse clutch selective retaining ring.



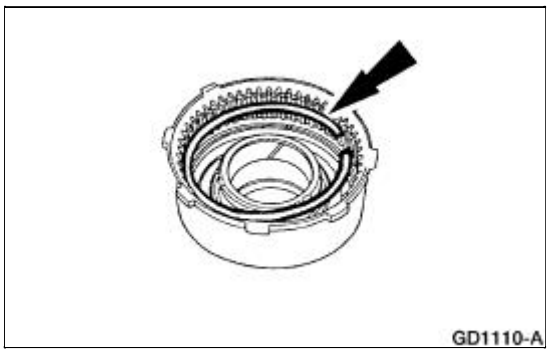
9. Remove the reverse clutch pack.



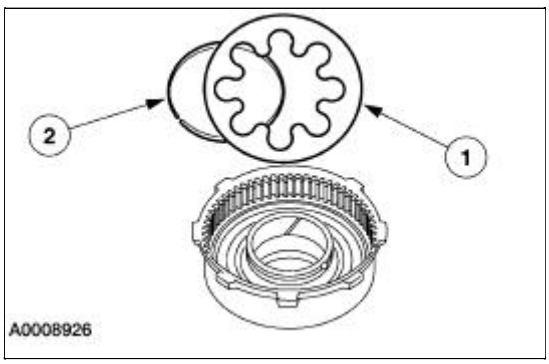
10. Using the special tools, compress the reverse clutch piston spring.



11. Remove the reverse clutch piston spring retaining ring.

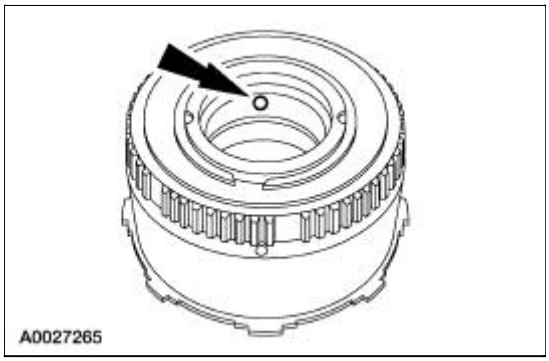


12. Remove the reverse clutch piston spring pressure ring.
    1. Remove the reverse clutch piston spring.
    2. Remove the reverse clutch piston spring pressure ring.

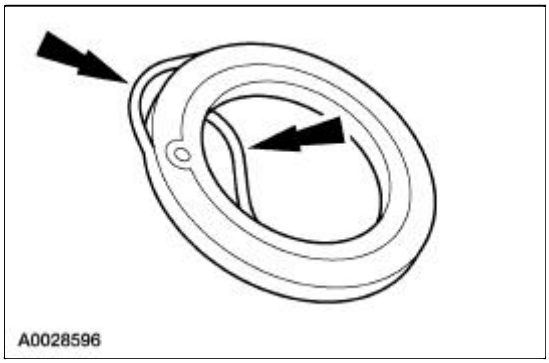


13. **NOTE:** To ease reverse clutch piston removal, it may be necessary to apply air pressure to the reverse clutch drum. Block the opposite hole.

    Remove the reverse clutch piston.



14. Remove the reverse clutch piston inner and outer seals.



Assembly

1. **NOTE:** One tab that locks the reverse clutch drum into the reverse sun shell may be removed. This is done for balancing purposes.

   Inspect the clutch cylinder thrust surfaces, piston bore and clutch plate serrations for scores or burrs. Minor scores or burrs may be removed with crocus cloth. Install a new clutch cylinder if badly scored or damaged.

2. Check the fluid passage in the clutch cylinder for obstructions. Clean out all fluid passages. Inspect clutch piston for scores and install new if necessary. Inspect the check balls for freedom of movement and correct seating.

3. Check the clutch release spring for distortion and cracks. Install a new spring (including wave spring) if distorted or cracked.

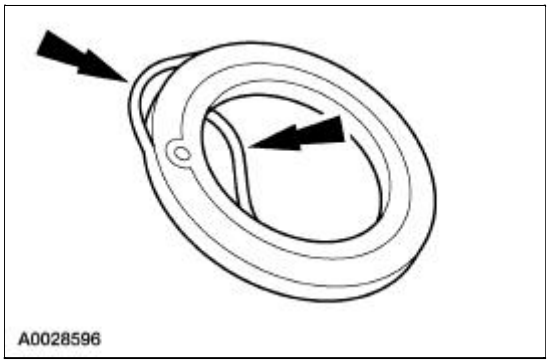
4. Inspect the composition clutch plates, steel clutch plates and clutch pressure plate for worn or scored bearing surfaces. Install new parts if they are deeply scored or burred.

5. Check the clutch plates for flatness and fit on the clutch hub serrations. Discard any plate that does not slide freely on serrations or that is not flat.

6. Check the clutch hub thrust surfaces for scores and clutch hub splines for wear.

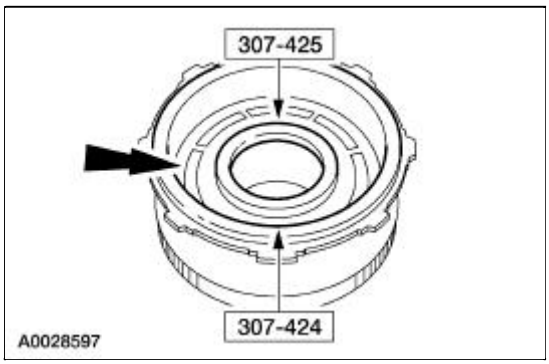
7. **NOTE:** The piston check ball must be present and moving freely.

   Install a new reverse clutch piston inner and outer seals.



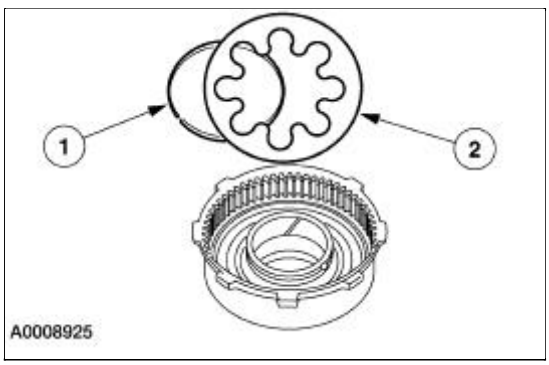
8. **NOTE:** Coat the reverse clutch piston inner seal, outer seal, drum sealing area and special tools with petroleum jelly.

   Using the special tools, install the reverse clutch piston using even pressure to push it to the bottom of the reverse clutch drum.

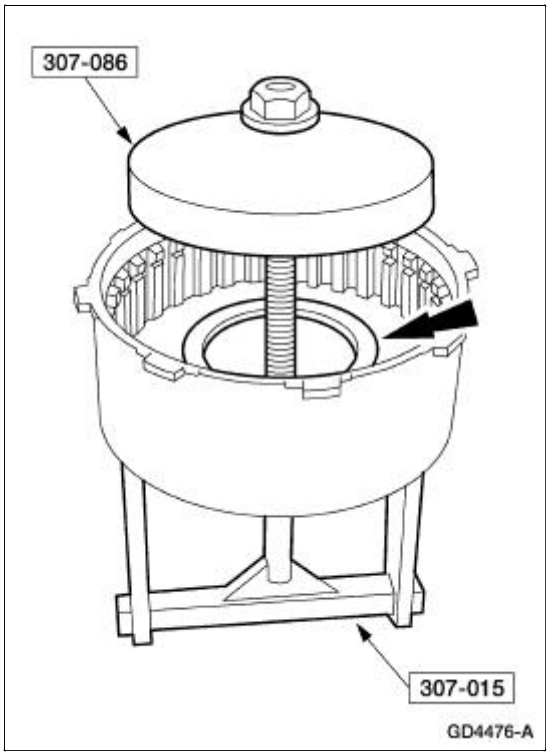


9. **NOTE:** The dished side of the reverse clutch piston spring must face the reverse clutch piston.

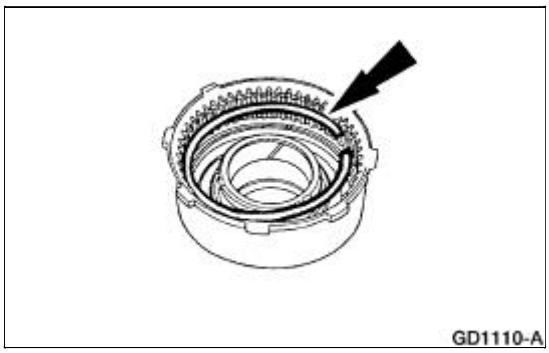
   Install the reverse clutch piston spring.
   1. Install the reverse clutch piston spring pressure ring.
   2. Install the reverse clutch piston spring.



10. Using the special tools, compress the reverse clutch piston spring.



11. Install the reverse clutch piston spring retaining ring.

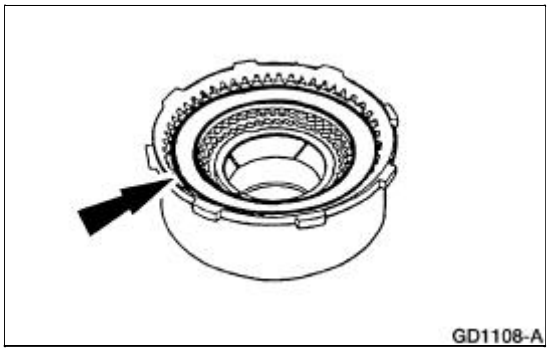


12. Remove the special tool.

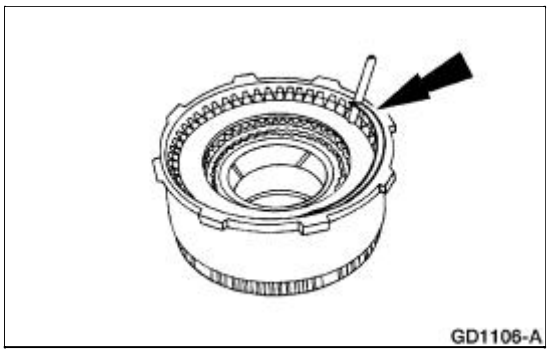
13. **CAUTION: Install the pressure plates with the flat sides facing the clutch pack.**

    NOTE: Before assembly, soak the new clutch discs in clean automatic transmission fluid for 15 minutes.

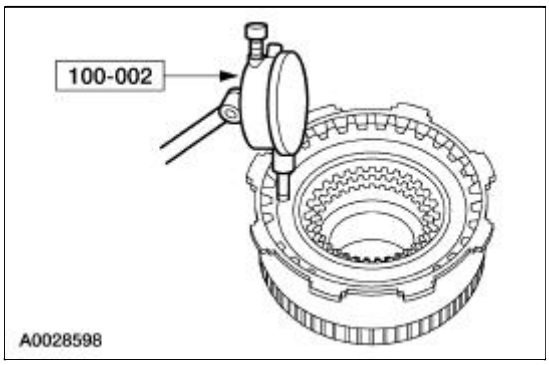
    Install the reverse clutch front pressure plate, clutch pack and reverse clutch rear pressure plate.



14. Install the reverse clutch pressure plate retainer snap ring.



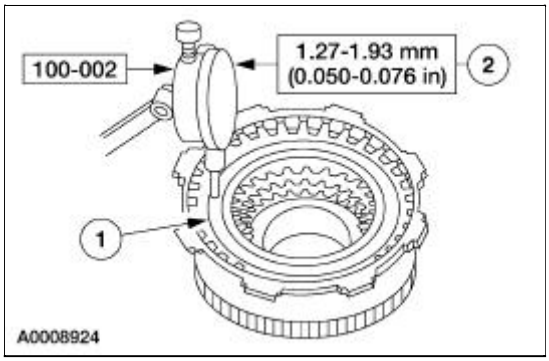
15. Install the special tool on the reverse clutch pack.
    - Push downward on the clutch pack.
    - Release pressure and zero the dial indicator.



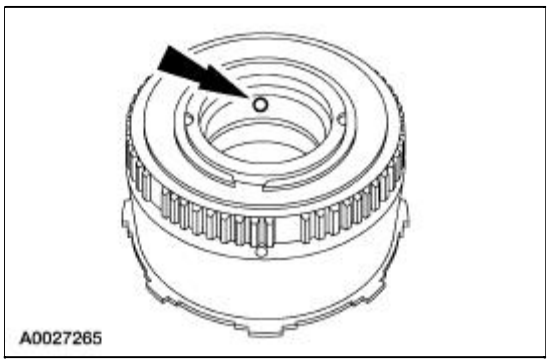
16. Using the special tool check the reverse clutch pack clearance.
    1. Lift up on the clutch pack until it fully seats against the reverse clutch pressure plate retainer.
    2. Read the dial indicator.
        - If clearance is not within specifications, install the correct size retaining ring.

Selective Retaining Rings

Specification
1.52-1.62 mm (0.060-0.064 inch)
1.87-1.98 mm (0.074-0.078 inch)
2.23-2.33 mm (0.088-0.092 inch)
2.59-2.69 mm (0.102-0.106 inch)

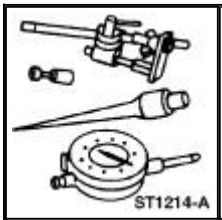


17. Check the clutch for correct operation.
    - Apply air pressure to the reverse clutch drum. The clutch should be heard and felt to work without leakage.



Forward Clutch Cylinder

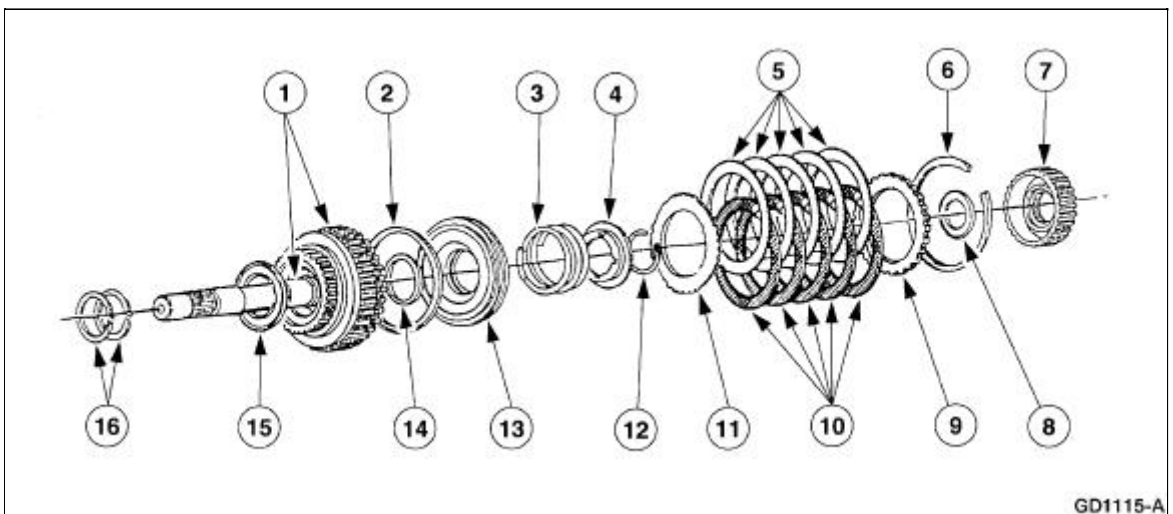
Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
ST1209-A	Compressor, Clutch Spring 307-096 (T81P-70235-A)
ST2693-A	Protector, Transmission Forward Clutch Outer Fluid Seal 307-423

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

Forward Clutch — Disassembled View



Item	Part Number	Description

1	7F207	Forward clutch cylinder and shaft
2	7A548	Forward clutch piston outer seal
3	7A480	Forward clutch piston return spring
4	7A527	Forward clutch retainer return spring
5	7B442	Forward clutch external spline plate (steel)
6	7D483	Retaining snap ring
7	7B067	Forward clutch hub
8	7F231	No. 3 forward clutch hub front bearing
9	7B066	Forward clutch pressure plate
10	7B164	Forward clutch internal spline plates (friction)
11	7E085	Forward clutch pressure spring
12	388099-S	Retaining snap ring
13	7A262	Forward clutch piston
14	7C099	Forward clutch piston inner seal
15	7A166	No. 2 forward clutch bearing
16	7B497	Input shaft seal

Disassembly

1. Inspect the clutch cylinder thrust surfaces, piston bore and clutch plate serrations for scores or burrs. Minor scores or burrs may be removed with crocus cloth. Install a new clutch cylinder if it is badly scored or damaged.

2. Check the fluid passage in the clutch cylinder for obstructions. Clean out all the fluid passages. Inspect the clutch piston for scores and install a new piston if necessary. Inspect check balls for freedom of movement and correct seating.

3. Check the clutch release spring for distortion and cracks. Install a new spring (including wave spring) if distorted or cracked.

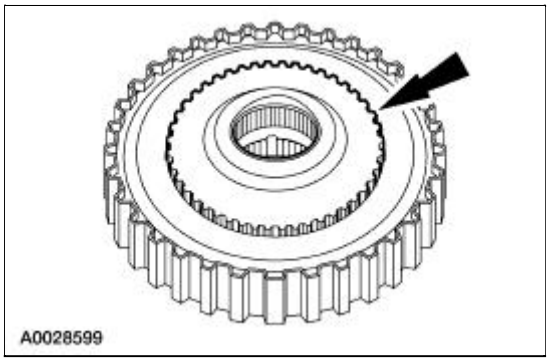
4. Inspect the composition clutch plates, steel clutch plates and clutch pressure plate for worn or scored bearing surfaces. Install new parts if they are deeply scored or burred.

5. Check the clutch plates for flatness and fit on clutch hub serrations. Discard any plate that does not slide freely on serrations or that is not flat.

6. Check the clutch hub thrust surfaces for scores and clutch hub splines for wear.

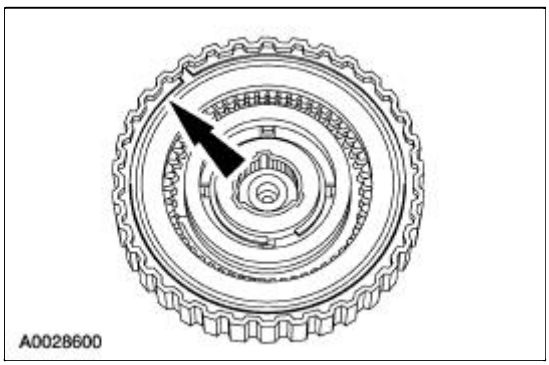
7. **NOTE:** The forward clutch hub may remain in the shell during disassembly.

   Remove the forward clutch hub and the No. 3 forward clutch hub front bearing.

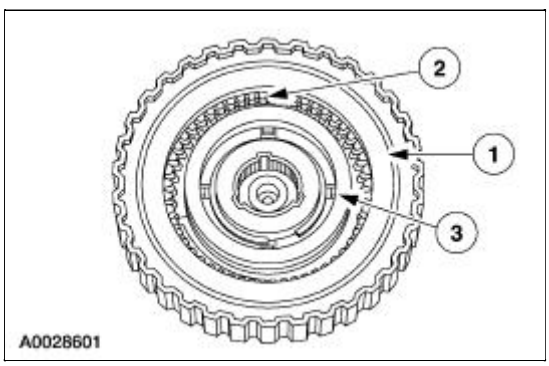


8. **NOTE:** To aid handling, the forward clutch assembly may be set in the extension housing or a hole in the work bench.

   Remove the forward clutch pack selective retaining ring.

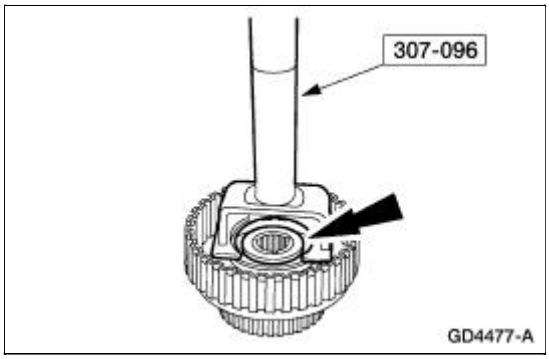


9. Remove the following components.
   1. Remove the pressure plate.
   2. Remove the clutch pack.
   3. Remove the pressure spring.



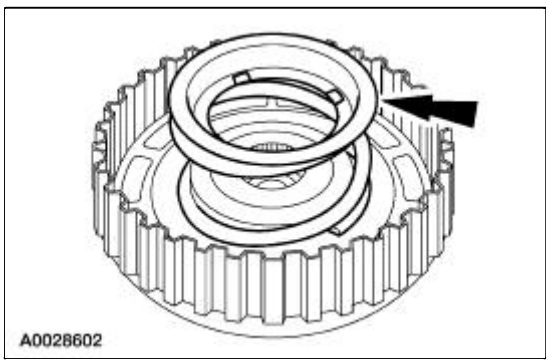
10. **CAUTION: Apply only enough pressure to release pressure on the retaining ring. If too much pressure is applied, the spring may break.**

    Using the special tool, remove the forward clutch retaining ring.



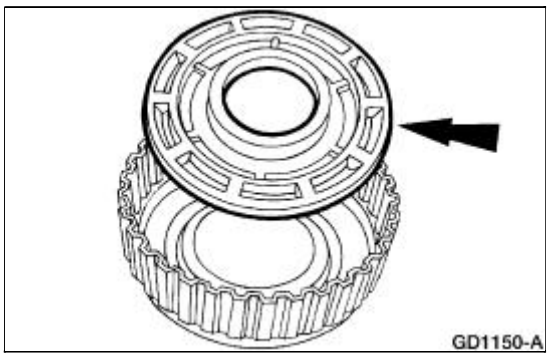
11. Slowly release the press and remove the forward clutch from the press.

12. Remove the forward clutch retainer and the return spring.

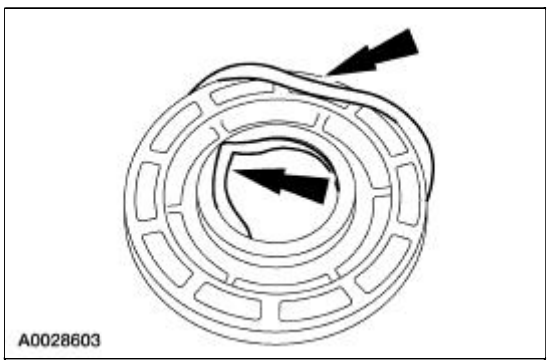


13. **NOTE:** Air pressure may be required to remove the forward clutch piston.

    Remove the forward clutch piston.

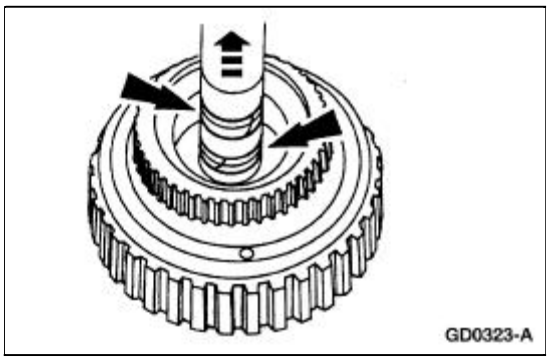


14. Remove the inner and outer forward clutch piston seals.

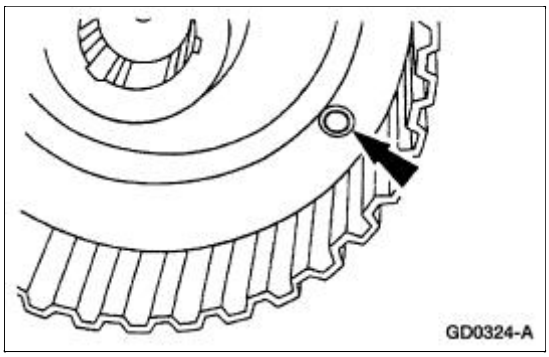


15. **NOTE:** The seals are solid seals, however, when installing new seals use scarf-cut seals.

    Remove the forward clutch input shaft seals.



16. Make sure the check ball in the clutch cylinder is free and clean. Check for correct seating.



Assembly

1. Inspect the clutch cylinder thrust surfaces, piston bore and clutch plate serrations for scores or burrs. Minor scores or burrs may be removed with crocus cloth. Install a new clutch cylinder if badly scored or damaged.

2. Check the fluid passage in the clutch cylinder for obstructions. Clean out all fluid passages. Inspect the clutch piston for scores and install a new piston if necessary. Inspect check balls for freedom of movement and correct seating.

3. Check the clutch release spring for distortion and cracks. Install a new spring (including the wave spring) if distorted or cracked.

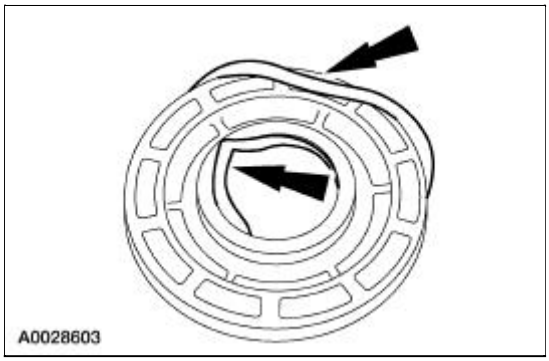
4. Inspect composition clutch plates, steel clutch plates and clutch pressure plate for worn or scored bearing surfaces. Install new parts if they are deeply scored or burred.

5. Check the clutch plates for flatness and fit on the clutch hub serrations. Discard any plate that does not slide freely on serrations or that is not flat.

6. Check the clutch hub thrust surfaces for scores and the clutch hub splines for wear.

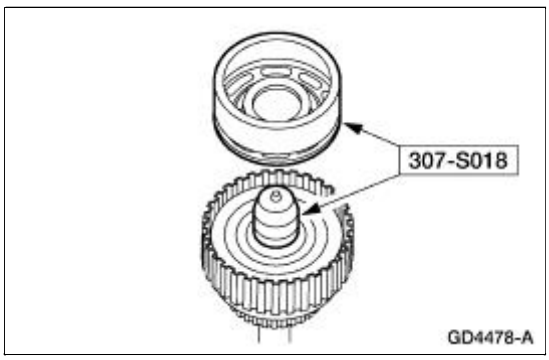
7. **NOTE:** To aid handling, the forward clutch assembly may be set in the extension housing or a hole in the work bench.

   Install the inner and outer forward clutch piston seals. Note the direction of the sealing rings before installation.

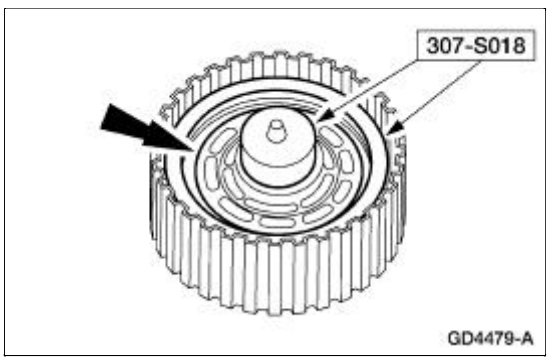


8. **NOTE:** Coat the piston seals and clutch drum sealing area with petroleum jelly.

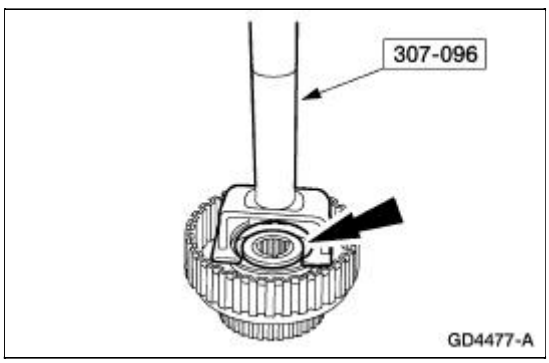
   Position the special tools on the clutch piston.



9. Using the special tools, install the forward clutch piston into the clutch drum.
   - Push the piston to the bottom of the drum using even pressure.



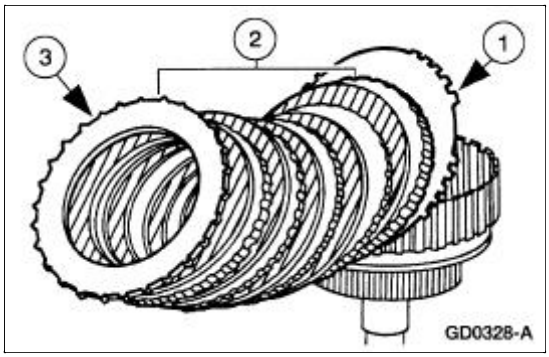
10. Using the special tool, compress the piston return spring and install the retaining ring.



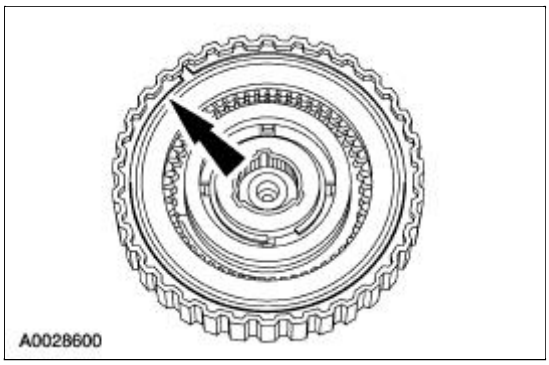
11. Slowly release the press pressure and remove the forward clutch.

12. **NOTE:** Before assembly, soak the new clutch discs in clean automatic transmission fluid for 15 minutes.

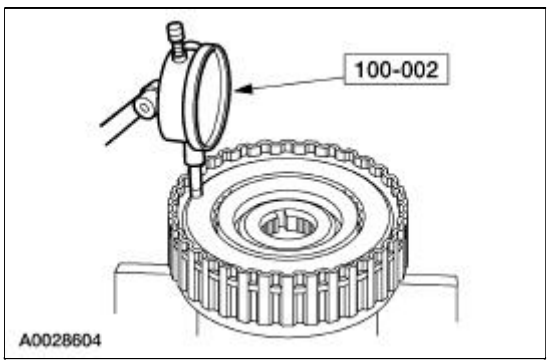
    Install the clutch pack assembly.
    1. Install the pressure ring.
    2. Install the clutch pack.
    3. Install the pressure plate.



13. Install the clutch pack retaining ring.



14. Install the special tool on the forward clutch pack.
    - Push downward on the clutch pack.
    - Release pressure and zero the dial indicator.

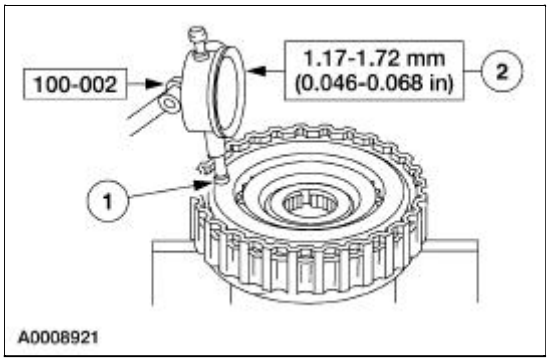


15. Using the special tool, check the clutch pack clearance.
    1. Lift up on the clutch pack until it fully seats against the clutch pressure plate retainer.
    2. Read the dial indicator.
        - If the clearance is not within specifications, install the correct size retaining ring.

Selective Retaining Ring

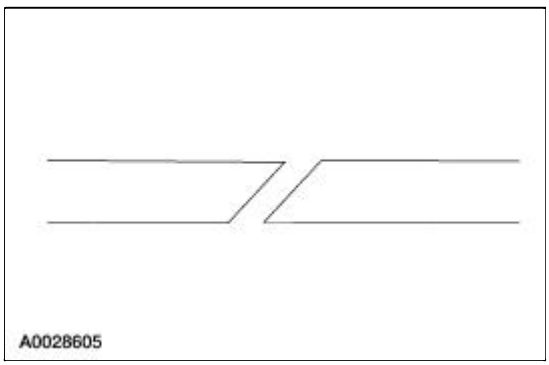
Specification

1.52-1.62 mm (0.060-0.064 inch)
1.87-1.98 mm (0.074-0.078 inch)
2.24-2.34 mm (0.088-0.092 inch)
2.59-2.69 mm (0.102-0.106 inch)

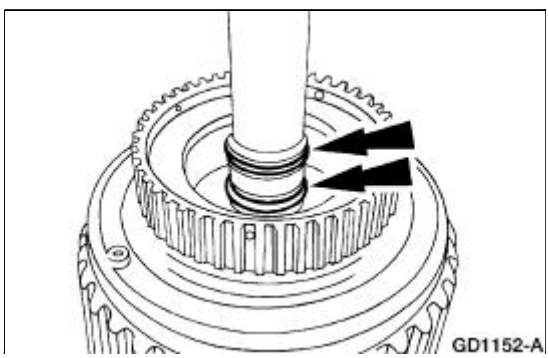


16. **NOTE:** Make sure the scarf-cut seals are mated correctly.

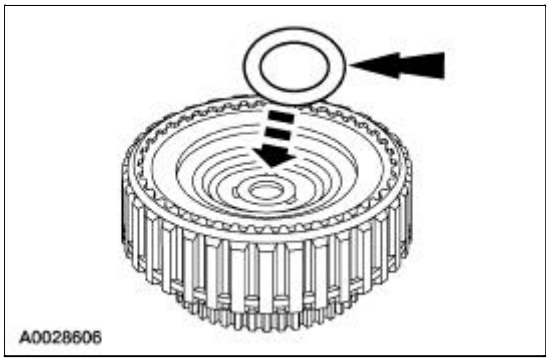
    Slide the two scarf-cut seals on the input shaft.



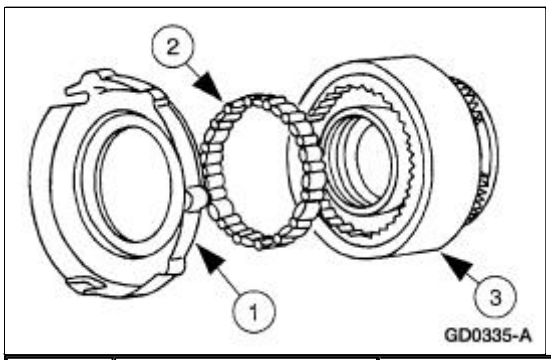
17. Install the two scarf-cut seals on the input shaft.



18. Install the No. 3 forward clutch hub front bearing and the forward clutch hub.


A0028606

Planetary Gear Support Assembly and Planetary One-Way Clutch

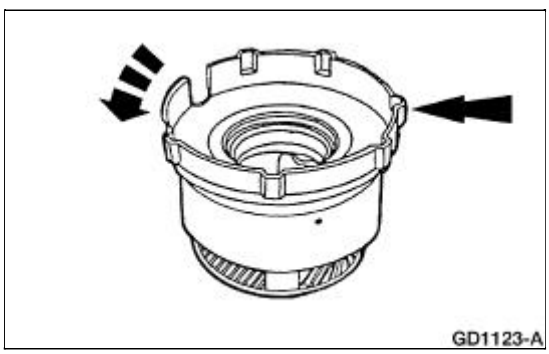


Item	Part Number	Description
1	7A130	Planetary gear support
2	7A089	Planetary one-way clutch
3	7A398	Planetary assembly

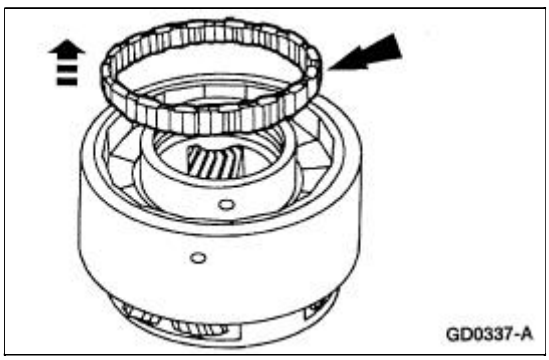
Disassembly and Assembly

1. **NOTE:** Inspect the outer and inner races for scores or damaged surface areas where rollers contact the races. Inspect the rollers and springs for excessive wear or damage. Inspect the spring and cage for bent or damaged spring retainers.

   Rotate the center support counterclockwise and lift to remove the planetary gear support.



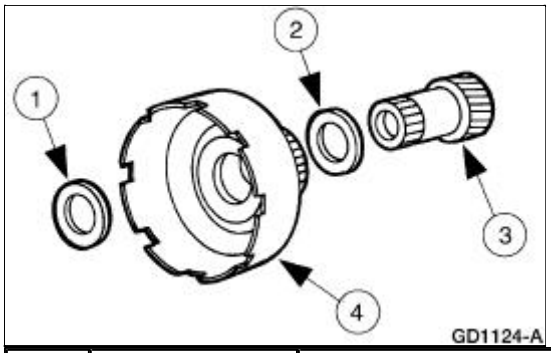
2. Remove the planetary one-way clutch.



3. To assemble, reverse the disassembly procedure.

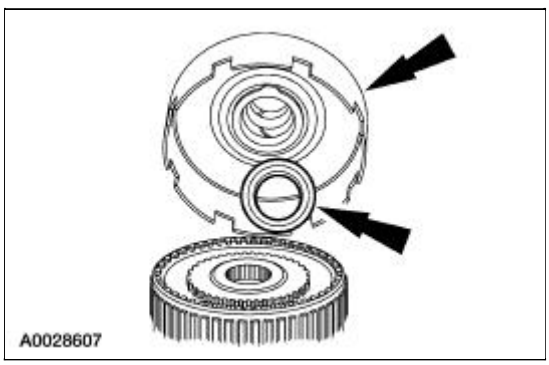
Reverse Sun Gear

Disassembly

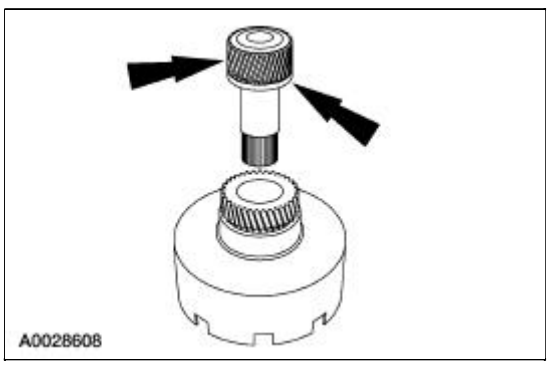


Item	Part Number	Description
1	7C096	Forward clutch hub bearing No. 4
2	7F244	Forward clutch sun gear bearing No. 5
3	7A399	Forward clutch sun gear
4	7A019	Reverse sun gear assembly

1. Remove the reverse clutch sun gear assembly and the No. 4 forward clutch hub bearing and race.



2. Remove the forward clutch sun gear assembly and the No. 5 forward clutch sun gear bearing and race.

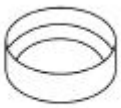


Assembly

1. The forward clutch sun gear and reverse sun gear assembly are assembled as part of the transmission assembly procedure.

Output Shaft and Direct Clutch Cylinder

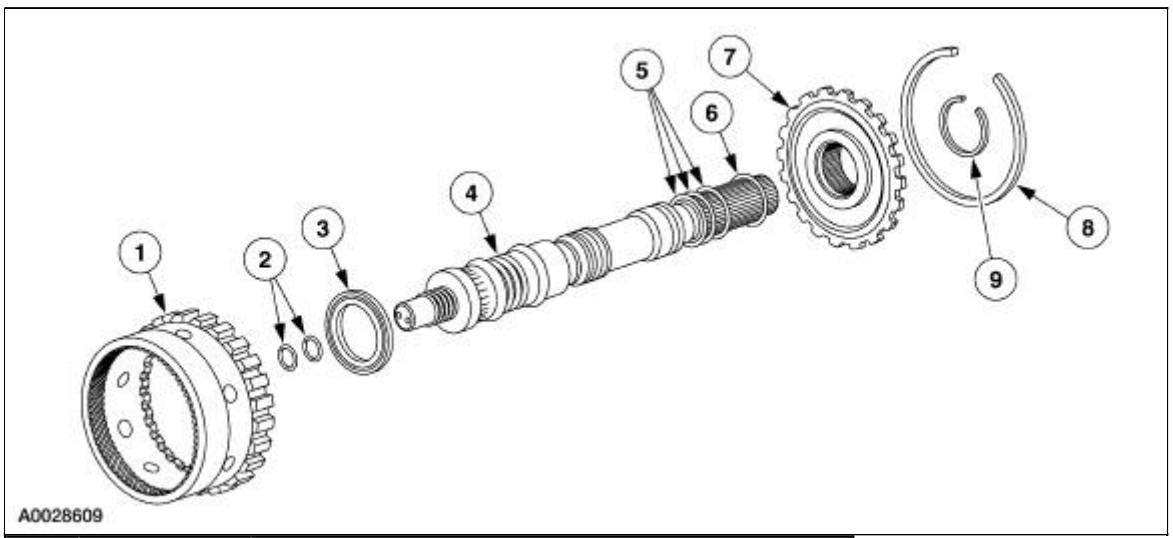
Special Tool(s)

ST1190-A	Compressor, Clutch Spring 307-015 (T65L-77515-A)
ST1204-A	Protector, Piston Seal 307-080 (T80L-77234-A)
 ST1901-A	Protector, Transmission Direct Clutch Outer Fluid Seal 307-422

Material

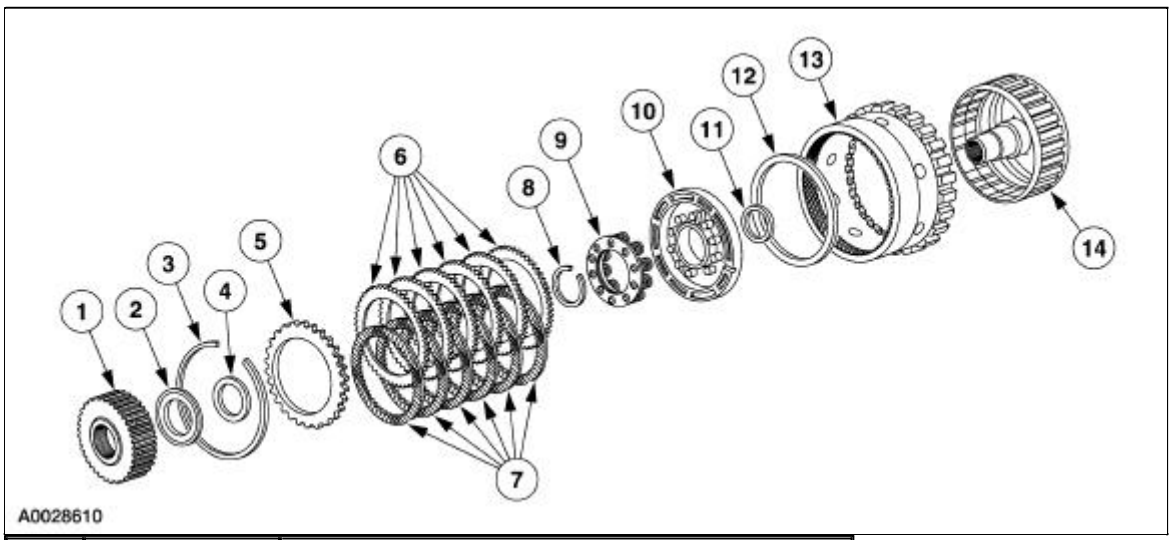
Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

Output Shaft, Direct Clutch Cylinder and Ring Gear Disassembled View



Item	Part Number	Description
1	7A233	Output shaft ring gear assembly
2	7F274	Output shaft to direct clutch cylinder seal (2 req'd)
3	7F240	Direct clutch outer bearing and race assembly No. 8
4	7060	Output shaft
5	7F273	Output shaft to case seal (3 req'd)
6	87054-S94	O-ring seal
7	7D164	Output shaft hub
8	97713-S	Retaining snap ring
9	7C122	Snap ring

Direct Clutch Disassembled View

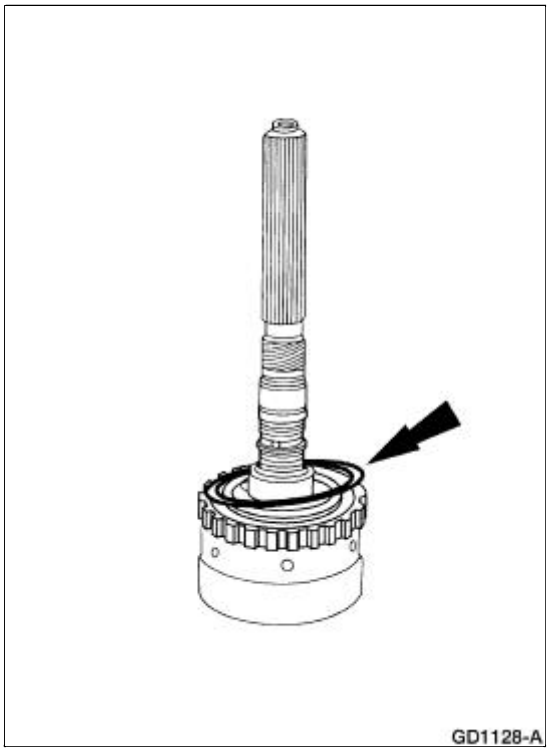


Item	Part Number	Description
1	7F236	Direct clutch hub
2	7F243	No. 7 direct clutch bearing
3	7D483	Direct clutch pressure plate retaining ring
4	7F237	Direct clutch inner bearing support
5	7B066	Direct clutch pressure plate
6	7B442	Direct clutch external spline plates (steel)
7	7B164	Direct clutch internal spline plates (friction)
8	388104-S2	Retaining ring
9	7F235	Direct clutch retainer and spring assembly
10	7A262	Direct clutch piston
11	7C099	Direct clutch piston inner seal
12	7A548	Direct clutch piston outer seal
13	7A233	Output shaft ring gear
14	7F283	Direct clutch cylinder

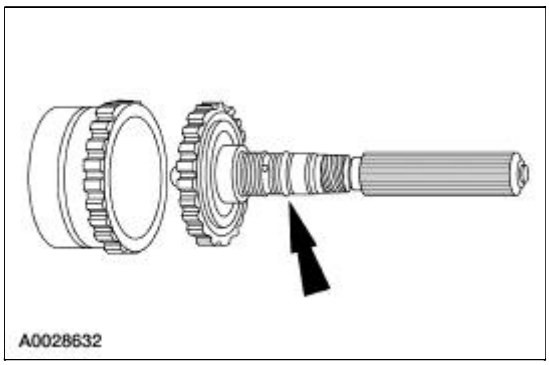
Disassembly

1. **NOTE:** The index mark on the output shaft must be aligned with the index mark on the output shaft ring gear during the assembly procedure.

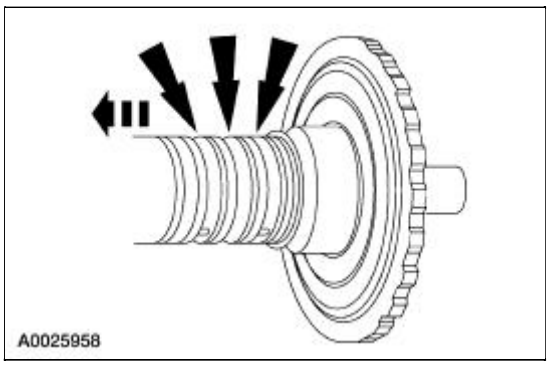
   Remove the ring gear snap ring.



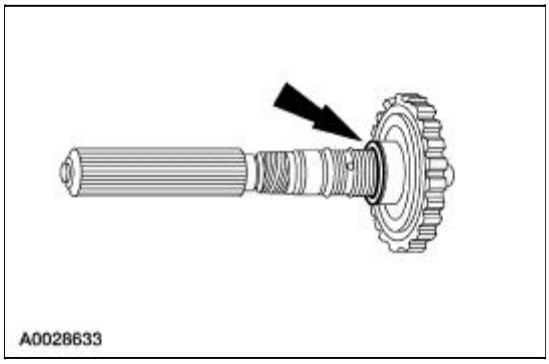
2. Separate the ring gear and output shaft.



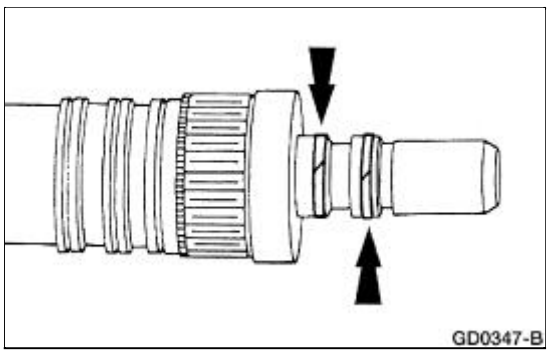
3. Remove the three output shaft seal rings.



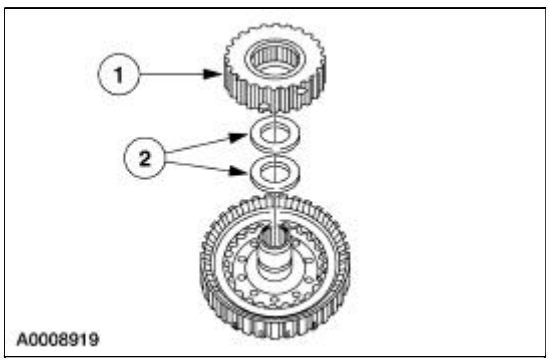
4. Remove the output shaft hub snap ring and the output shaft hub.



5. Remove the two direct clutch seal rings.



6. Remove the No. 7 direct clutch inner bearing support.
    1. Remove the direct clutch hub.
    2. Remove the No. 7 direct clutch inner bearing support.



7. Inspect the clutch cylinder thrust surfaces, piston bore and clutch plate serrations for scores or burrs. Minor scores or burrs may be removed with a crocus cloth. Install a new clutch cylinder if badly scored or damaged.

8. Check the fluid passage in the clutch cylinder for obstructions. Clean out all fluid passages. Inspect the clutch piston for scores and install new if necessary. Inspect the check balls for freedom of movement and correct seating.

9. Check clutch release spring for distortion and cracks. Install a new spring (including wave spring) if distorted or cracked.

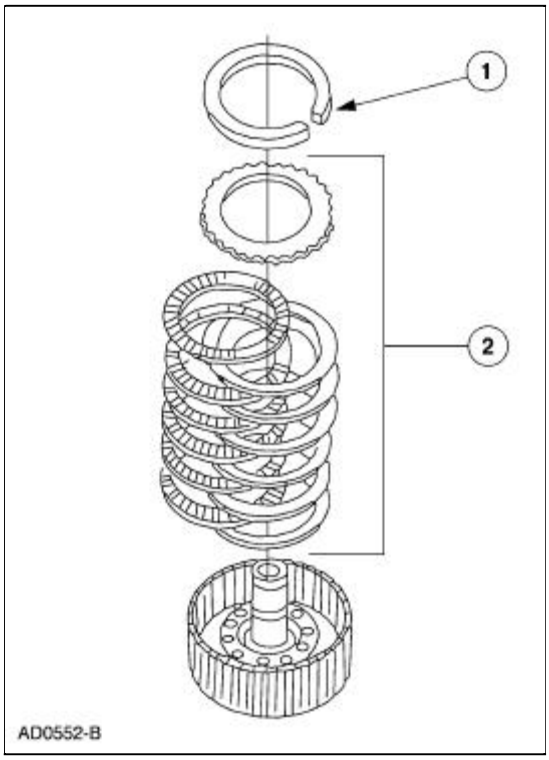
10. Inspect composition clutch plates, steel clutch plates and clutch pressure plate for worn or scored bearing surfaces. Install new parts if they are deeply scored or burred.

11. Check the clutch plates for flatness and fit on the clutch hub serrations. Discard any plate that

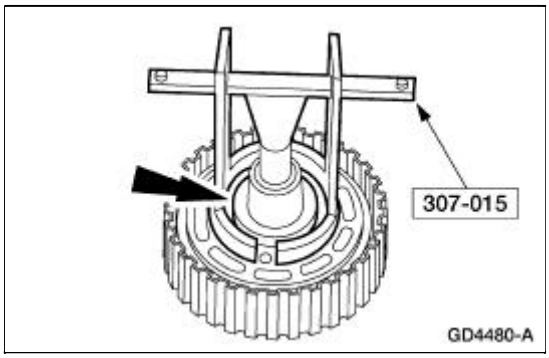
does not slide freely on the serrations or that is not flat.

12. Check the clutch hub thrust surfaces for scores and clutch hub splines for wear.

13. Remove the direct clutch pack.
    1. Remove the selective retaining ring.
    2. Remove the direct clutch pack.



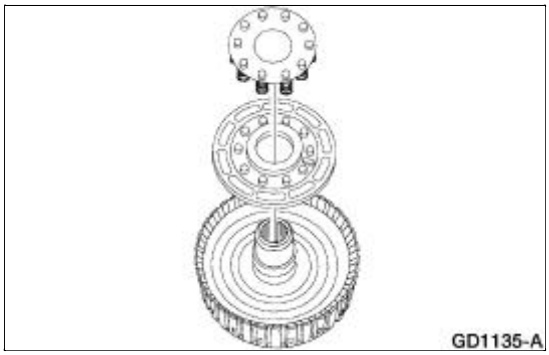
14. Using the special tool, compress the piston return spring and remove the snap ring.



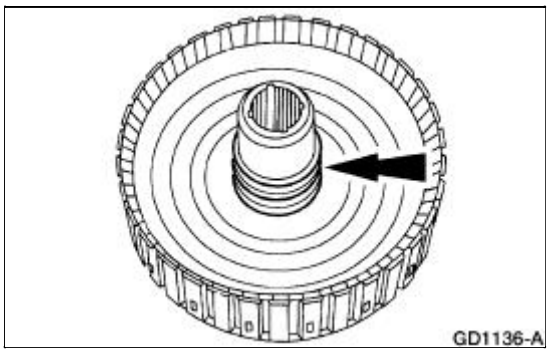
15. **WARNING: Wear safety glasses when using compressed air.**

    NOTE: If necessary, use regulated compressed air 207 kPa (30 psi) max pressure to remove the clutch piston.

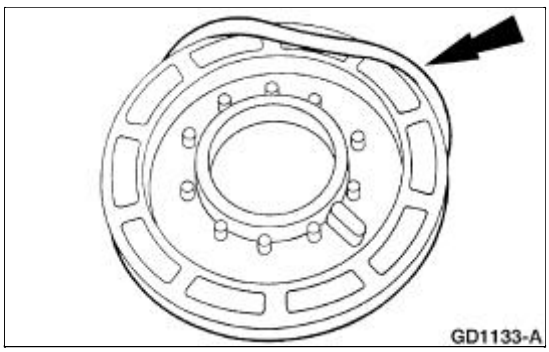
    Remove the support and spring assembly and piston.



16. Remove the inner piston seal.



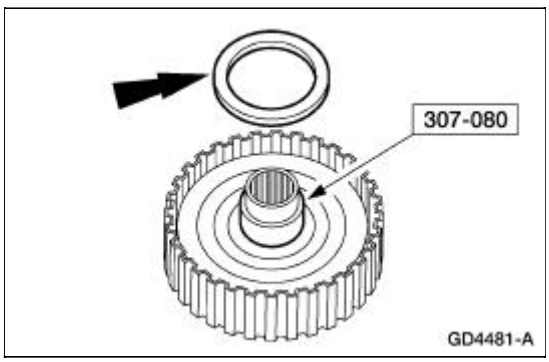
17. Remove the outer piston seal.



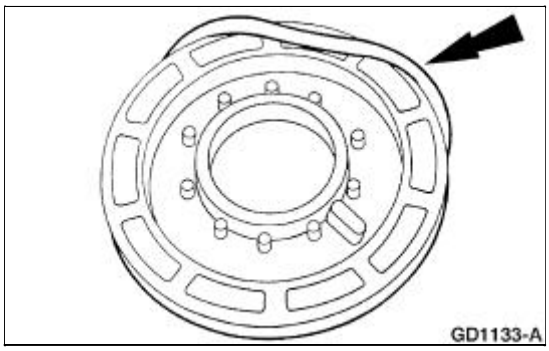
Assembly

1. **NOTE:** Lubricate direct clutch piston inner seal and seal protector with petroleum jelly.

   Using the special tool, install the inner piston seal.
   - Install the seal with sealing lip facing down.

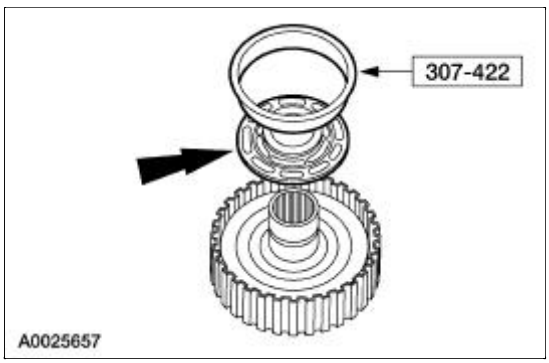


2. Install the clutch piston outer seal so that when the piston is installed the sealing lip points toward the bottom of the cylinder.



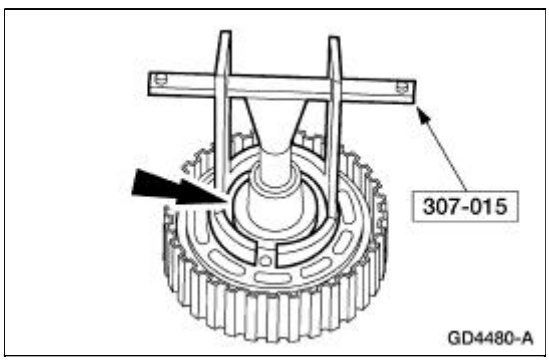
3. **NOTE:** Coat the inner and outer direct clutch piston seals, clutch cylinder sealing area and piston inner sealing area with petroleum jelly.

   Using the special tool, install the direct clutch piston.



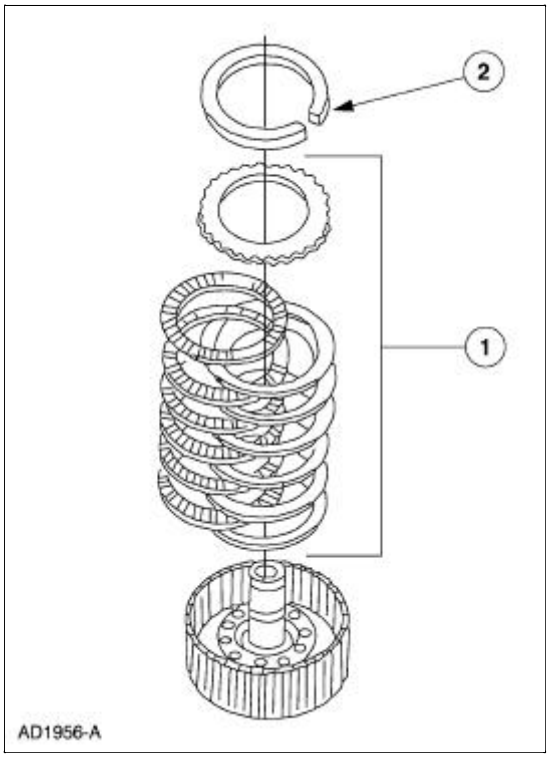
4. Install the piston return spring and retainer assembly.

5. Using the special tool, compress the piston return spring and install the retaining ring.



6. **NOTE:** Before assembly, soak new clutch discs in clean automatic transmission fluid for 15 minutes.

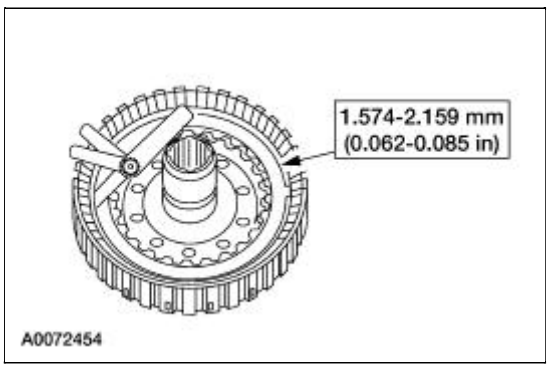
   Install the clutch pack retaining ring.
   1. Alternate external spline (steel) plates and internal spline (friction) plates, starting with a steel plate and ending with the friction plate.
   2. Install the clutch pack retaining ring.



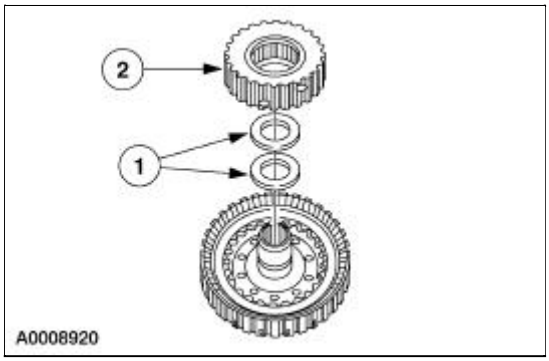
7. Use a feeler gauge to check the clearance between the clutch pack selective retaining ring and the pressure plate.
    - If the clearance is not within specifications, install the correct size retaining ring and recheck the clearance.

Selective Retaining Ring

Specification
1.52-1.62 mm (0.060-0.064 inch)
1.87-1.98 mm (0.074-0.078 inch)
2.24-2.34 mm (0.088-0.092 in)
2.59-2.69 mm (0.102-0.106 inch)



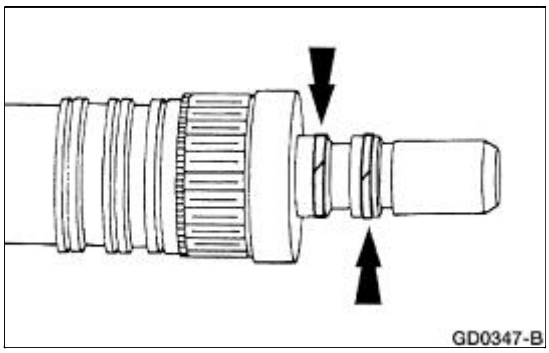
8. Install the direct clutch hub.
    1. Install the No.7 direct clutch inner bearing support.
    2. Install the direct clutch hub.



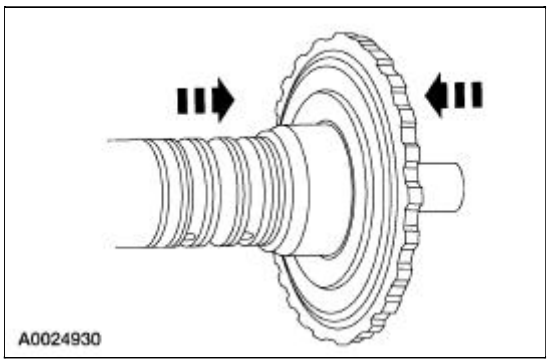
NOTE: Inspect the output shaft bearing surfaces for scores. Inspect the output shaft splines for wear. Inspect all bushings.

9. **CAUTION: Make sure the seals are lapped correctly. Internal damage may occur.**

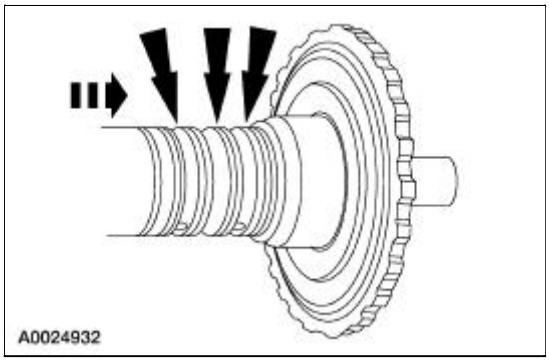
   Install the two direct clutch seal rings.



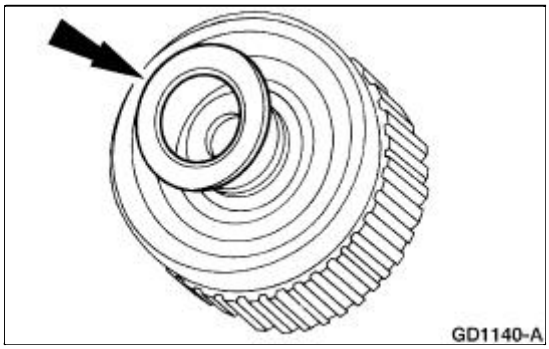
10. Install the output shaft hub.
    - Position the output shaft hub.
    - Install the retaining ring.



11. Install the three output shaft seal rings.

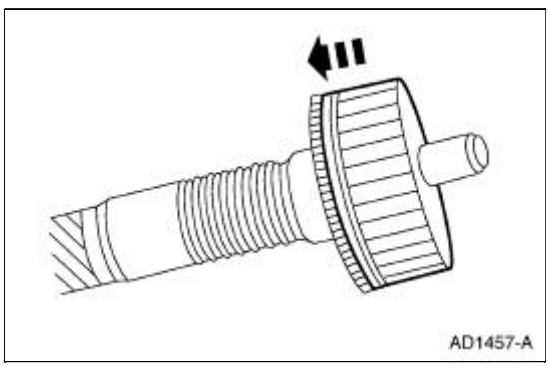


12. Install the No. 8 needle bearing on the direct clutch cylinder.



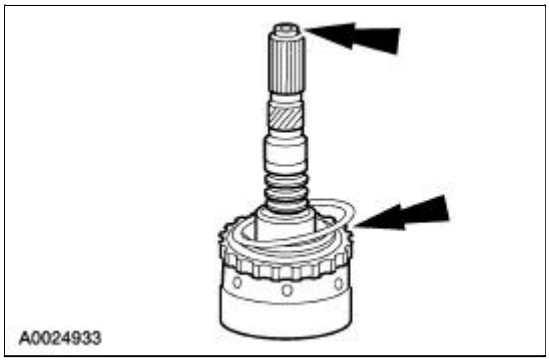
13. **NOTE:** Direct clutch cylinder may be installed after the output shaft ring gear is installed to the output shaft hub.

    Assemble the direct clutch on the output shaft.



14. **CAUTION: The index mark on the output shaft must be aligned with the index mark on the output shaft ring gear.**

    Align the index marks on output shaft and the output shaft ring gear and install the ring gear on the output shaft.


A0024933

Torque Converter

1. A new or remanufactured torque converter must be installed if one or more of the following statements is true:
    - A torque converter malfunction has been determined based on complete diagnostic procedures.
    - Converter stud or studs, impeller hub or bushing are damaged.
    - Discoloration (due to overheating).
    - The torque converter is found to be out of specification when carrying out one of the following torque converter checks:
        - One-Way Clutch Check
        - End Play Check
        - Stator to Turbine Interference Check
        - Stator to Impeller Interference Check
        - Torque Converter Leak Check
    - Evidence of transmission assembly or fluid contamination due to the following transmission or converter failure modes:
        - Major metallic failure.
        - Multiple clutches or clutch plate failures.
        - Sufficient component wear which results in metallic contamination.

Torque Converter Cleaning And Inspection

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

1. If a new torque converter is being installed, continue with Substep 2 of Step 2.

2. If a new torque converter is not being installed, the following procedures must be performed:
    1. The torque converter must be thoroughly cleaned.
        - Torque converters with drain plugs can be cleaned by using a suitable torque converter/fluid cooler cleaner.
        - Torque converters without drain plugs can be cleaned by hand. Partially fill the torque converter using only recommended transmission fluid for the applicable transmission. Hand agitate the torque converter and then thoroughly drain the fluid. Refill the torque converter with clean automatic transmission fluid specified for transmission, and reinstall.
    2. All in-tank and auxiliary coolers must be thoroughly cleaned by forward and backward flushing. For additional information, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.
    3. All cooler lines must be thoroughly cleaned by backward and forward flushing. For additional information, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.
    4. All Cooler Bypass Valves (CBV), if equipped, must be thoroughly cleaned.
    5. Carry out the Transmission Fluid Cooler Flow Test. For additional information, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.
    6. If the transmission cooling system fails the Transmission Fluid Cooler Flow Test, a new fluid cooler, cooler bypass valve, and/or cooler lines must be installed. For additional information, refer to Section 307-02 .
    7. If new coolers are to be installed, use only factory approved service parts.

Torque Converter Flushing

Material

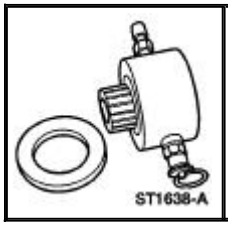
Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

NOTE: When the transmission has been repaired for internal damage the torque converter must be cleaned using a mechanically agitated cleaner.

1. Using a suitable torque converter/fluid cooler cleaner, clean and flush the torque converter.
2. After flushing, drain the remainder of the solvent.
3. Add 1.9 liter (2 qt.) of clean transmission fluid to the converter and agitate by hand.
4. Thoroughly drain the solution.

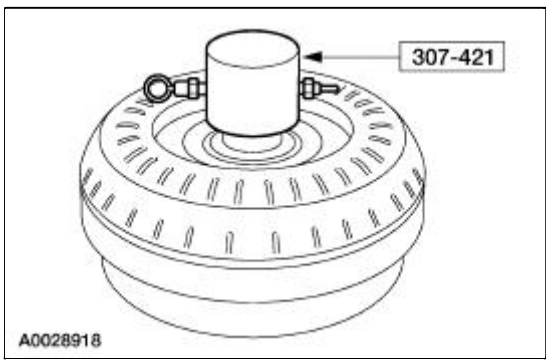
Torque Converter Leak Check

Special Tool(s)

	Leak Tester, Torque Converter 307-421

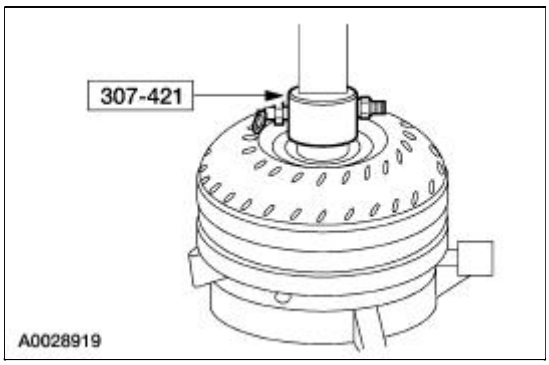
1. Clean the outside surface of the torque converter.

2. Install the special tool into the converter hub.



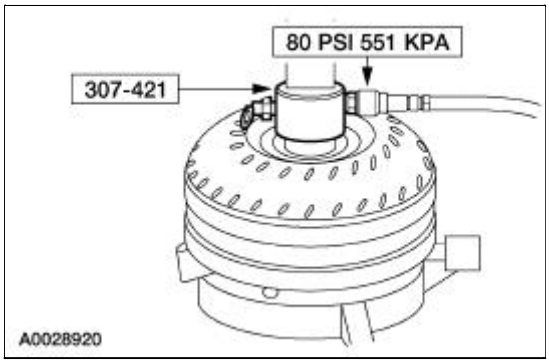
3. **WARNING: Always follow correct safety procedures while using press. Failure to follow these instructions may result in personal injury.**

   Install the torque converter with the installed special tool into the arbor press.
   Secure the press, apply enough force to seal the tool into the torque converter.

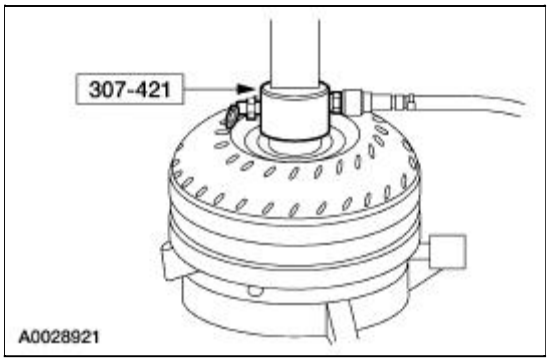


4. **NOTE:** Use clean dry shop air.

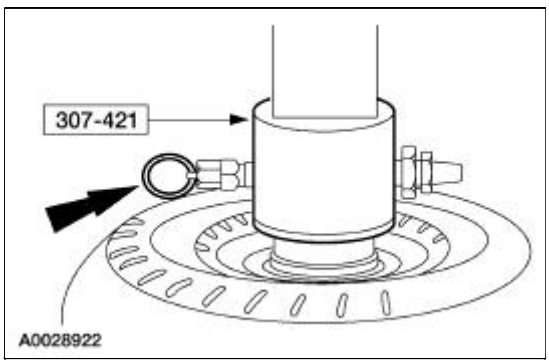
   Apply air pressure to the valve on the special tool.



5. With air pressure applied to the valve, inspect for leaks at the converter hub, seams, drain plug and studs. A soap bubble solution may be applied around these areas to aid in diagnosis. If a leak is found around the drain plug, install a new drain plug and recheck the torque converter. If any other leaks are present, install a new or remanufactured torque converter.



6. Remove the air hose. Release pressure and then slowly release the press. Remove the torque converter. Remove the special tool.

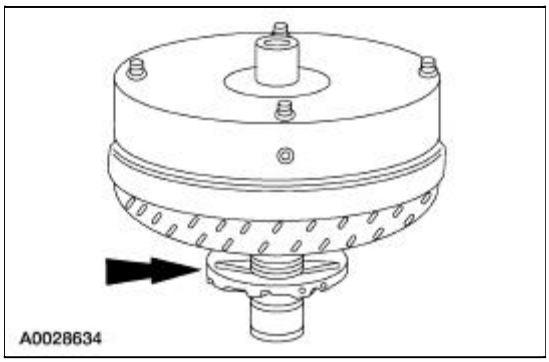


Torque Converter Impeller to Pump Stator Interference Check

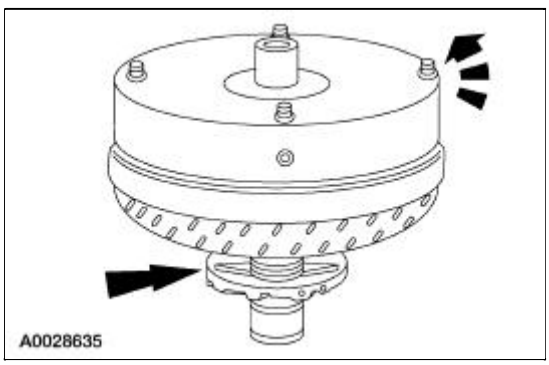
1. **NOTE:** Front pump support may remain in front pump support and gear during this test.

   Position the front pump support with the splines up.

2. Mount the torque converter on the front pump support with the splines on the one-way clutch inner race, engaging the mating splines of the front pump support.

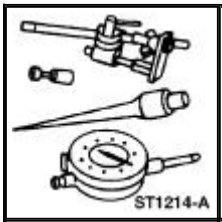


3. Hold the front pump support stationary and rotate the torque converter counterclockwise.
   - The torque converter should rotate freely with no signs of scraping.
   - If there are signs of scraping, install a new or remanufactured torque converter.

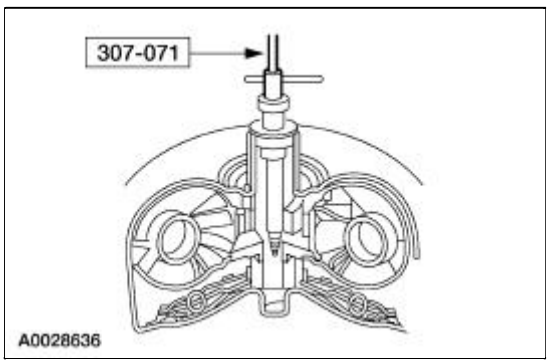


Torque Converter End Play Check

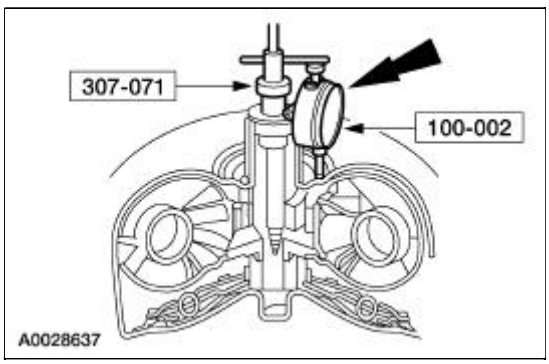
Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
ST1196-A	End Play Gauge, Torque Converter 307-071 (T80L-7902-A) or equivalent

1. Install the special tool into the torque converter pump drive.
   - Tighten the inner post until the tool is securely locked.



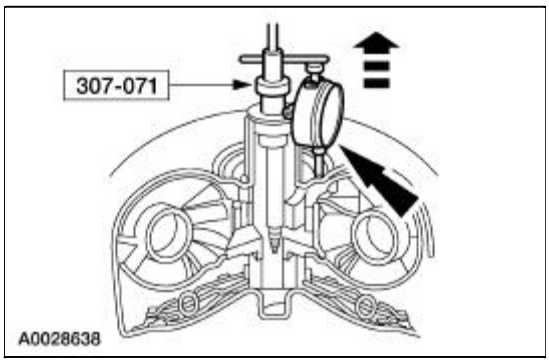
2. Install the special tool on the converter pump drive hub and zero the dial indicator.



3. Lift up on the special tool and note the dial indicator reading.
   - If the reading exceeds end play limits, install a new or remanufactured torque converter.

Torque Converter End Play

New or Rebuilt Torque Converter	Used Torque Converter
0.355-1.04 mm (0.014-0.041 inch) Max.	0.355-1.87 mm (0.014-0.074 inch) Max.



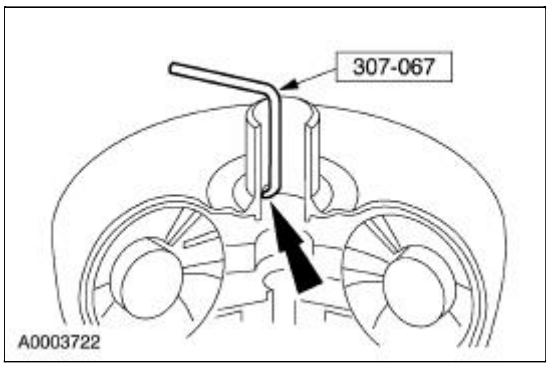
4. Remove the special tools.

Torque Converter One-Way Clutch Check

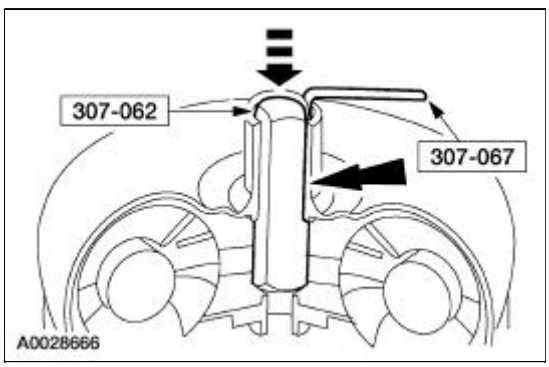
Special Tool(s)

ST1193-A	Holding Tool, One-Way Clutch 307-062 (T76L-7902-C) or equivalent
ST1195-A	Holding Tool, Torque Converter Clutch 307-067 (T77L-7902-R) or equivalent

1. Install the special tool in one of the grooves in the stator thrust washer.

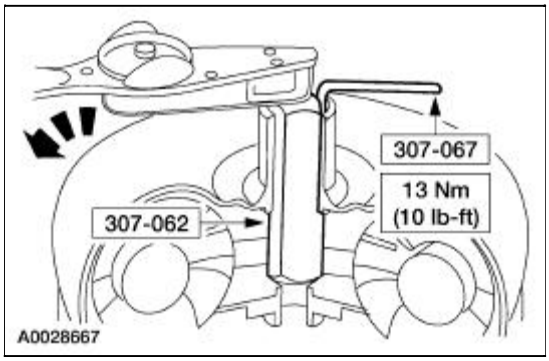


2. Install the special tool in the converter pump drive.



3. Use a torque wrench to turn the special tool counterclockwise while holding the special tool stationary.
   - The converter should lock up and hold torque.
   - The torque converter one-way clutch should rotate freely in the clockwise direction.
   - Try the clutch for lockup and hold in at least five positions.

- If the torque converter fails the lockup test torque, install a new or remanufactured torque converter.

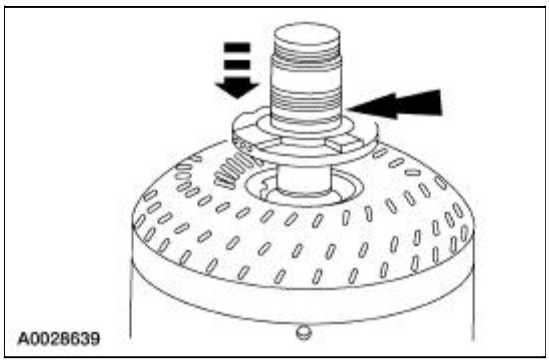


Torque Converter Turbine to Pump Stator Interference Check

1. **NOTE:** Front pump support may remain in front pump support and gear during this test.

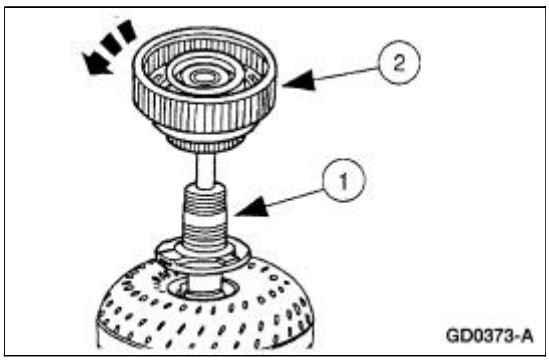
   Position the torque converter with the pump drive up.

2. Install the front pump support to engage the mating splines of the front pump support shaft on the torque converter.



3. Install the forward clutch cylinder and shaft, engaging the splines with the rear clutch hub.

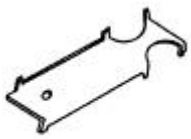
4. Check for stator to turbine interference.
   1. Hold the front pump support stationary.
   2. Attempt to rotate the forward clutch cylinder and shaft.
      - The turbine and torque converter clutch assemblies should rotate in both directions, not exceeding maximum torque of 9.5 Nm (7 lb-ft), without any signs of metallic interference or scraping noise.

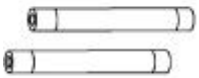


5. If interference exists, the stator front thrust washer may be worn, allowing the stator to hit the turbine. In such cases, a new or remanufactured torque converter must be installed.
   - The converter crankshaft pilot should be checked for nicks or damaged surfaces that could cause interference when installing the torque converter into the crankshaft. Check the converter front impeller hub for nicks or sharp edges that would damage the pump seal.

Transmission

Special Tool(s)

ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
ST2467-A	Rubber Tip Air Nozzle 100-D009 (D93L-7000-A)
 ST1633-A	Alignment Gauge, TR Sensor 307-351 (T97L-70010-A)
ST1185-A	Slide Hammer 100-001 (T50T-100-A)
ST1199-A	Installer, Shift Shaft Fluid Seal 307-050 (T74P-77498-A)
ST1197-A	Shim Selection Gauge 307-072 (T80L-77003-A)
ST1202-A	Installer, Servo Piston 307-073 (T80L-77030-A)
	Remover/Installer, Transmission Extension Housing

ST1216-A	307-077 (T80L-77110-A)
 ST1631-A	Handle, Torque Converter 307-091 (T81P-7902-C)
ST1940-A	Test Plate Screw Set, Transmission 307-126 (T82P-7006-C)
ST1392-A	Air Test Plate, Transmission 307-246 (T92P-7006-A)
ST1210-A	Remover/Installer, Servo Piston 307-251 (T92P-70023-A)
ST1636-A	Retainer, Torque Converter 307-346 (T97T-7902-A)
ST1188-A	Installer, Transmission Extension Housing Oil Seal 308-002 (T61L-7657-A)
ST2545-A	Gauge, Transmission Solenoid Connectors 307-426

Material

Item	Specification
Multi-Purpose Grease	ESB-M1C93-

D0AZ-19584-AA	B
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

CAUTION: Before beginning assembly, carry out and inspect the following:

When building up subassemblies and assembling the transmission, ALWAYS use new gaskets and seals.

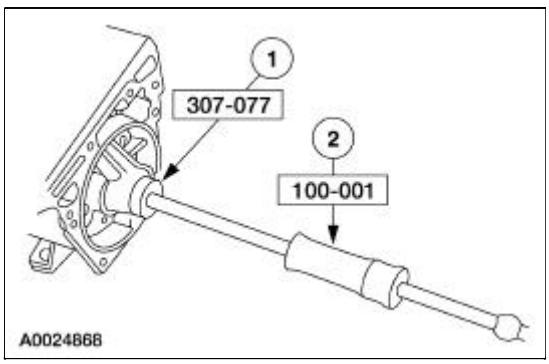
All fasteners must be tightened to the torque specification indicated. In addition to appearing in the section, the necessary torques can be found in the General Specifications Chart.

When building up subassemblies, each component part should be lubricated with clean transmission fluid. It is also good practice to lubricate the subassemblies as they are installed in the case.

Needle bearings, thrust washers and seals should be lightly coated with petroleum jelly during subassembly buildup or transmission assembly.

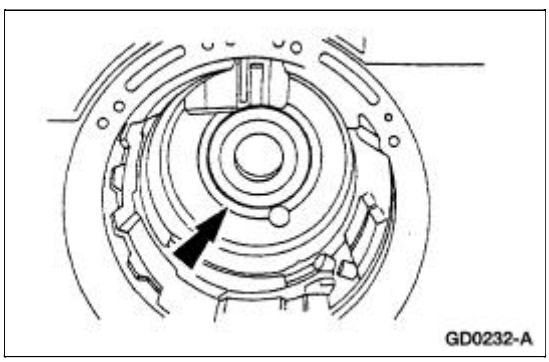
Many components and surfaces in the transmission are precision machined. Careful handling during disassembly, cleaning, inspection and assembly can prevent unnecessary damage to machined surfaces.

1. Use the special tools to install the rear case bushing if removed.
    1. Position the rear case bushing and the special tool inside the case.
    2. Assemble the special tools through the back of the case.



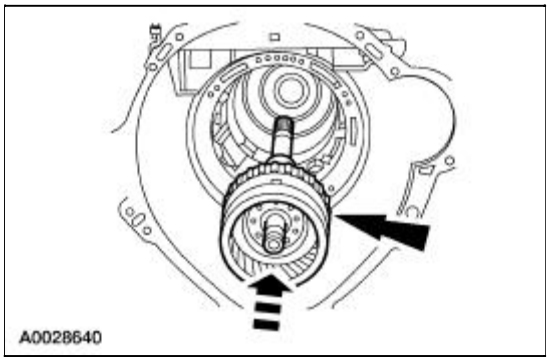
2. Place the transmission in the vertical position.

3. Coat the No. 9 case rear bearing with petroleum jelly and install on the case boss.

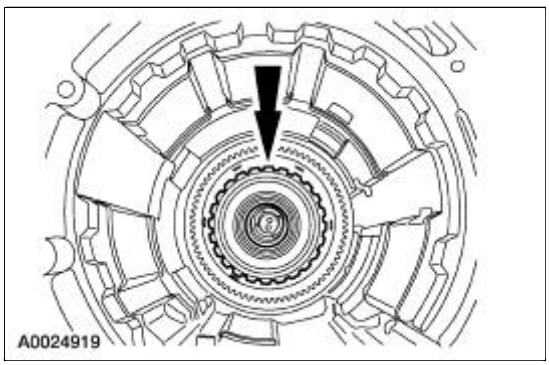


4. **CAUTION: Be sure the No. 7 needle bearing and direct clutch hub are installed as shown in the Subassembly section. Internal damage and shift problems may occur.**

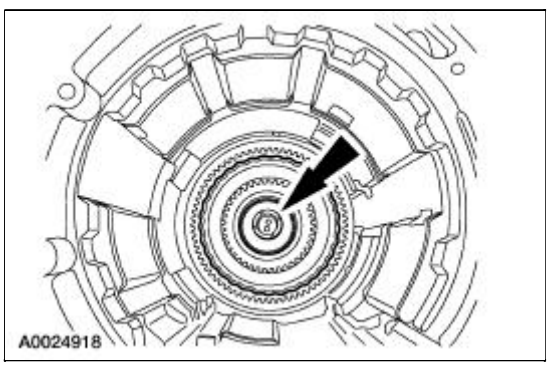
Install the output shaft and output shaft ring gear.



5. Install the No. 8 bearing.

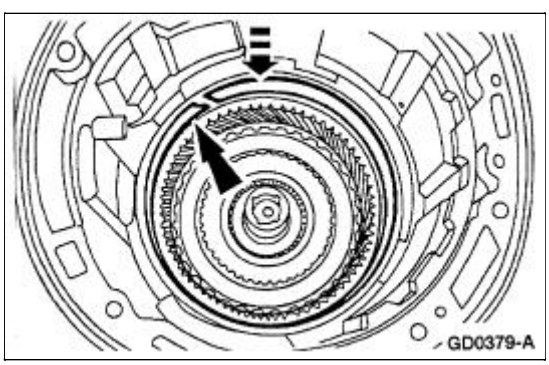


6. Install the direct clutch.



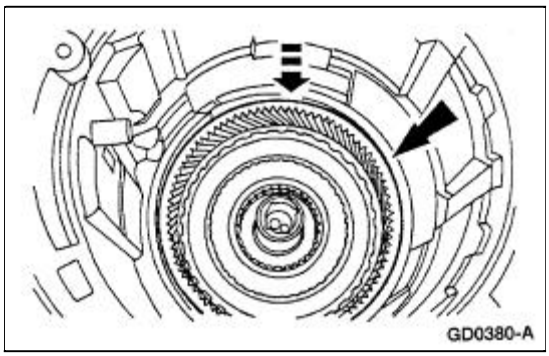
7. **NOTE:** The reverse band support retaining ring is used for assembly purposes during production. The reverse band support retaining ring is not required during assembly and it will not affect the operation of the transmission.

   Install the reverse band support retaining ring.



8. **NOTE:** Make sure the band is seated on the anchor pins.

   Install the reverse band.

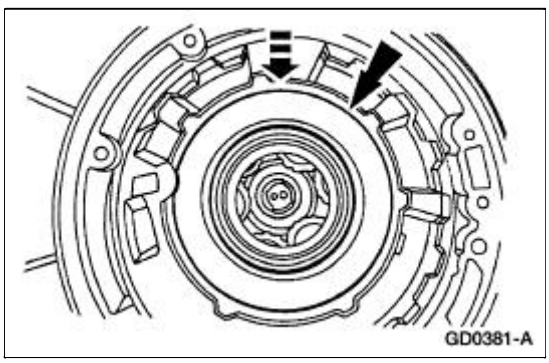


9. **NOTE:** The planetary assembly and planetary gear support cannot be installed unless the notch cut in the planetary gear support is aligned with the overdrive band anchor pin.

   NOTE: The top of the planetary gear support must be below the snap ring groove.

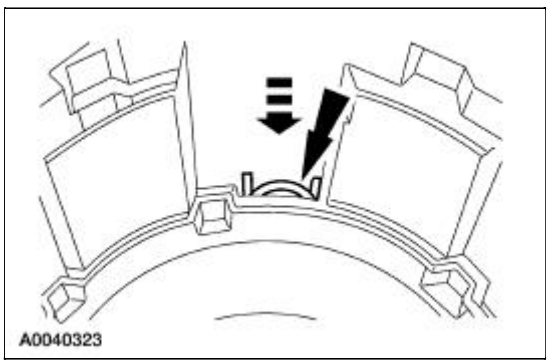
   Install the planetary assembly and planetary gear support as a unit.

   - Rotate the output shaft to fully seat the planetary assembly.



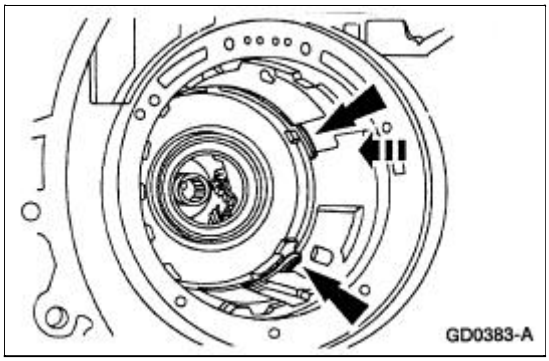
10. **NOTE:** The planet support spring must be compressed and installed below the snap ring groove. When the planet support spring is installed correctly both ends of the spring will be visible.

    Install the case to the planet support spring located at the 1 o'clock position.

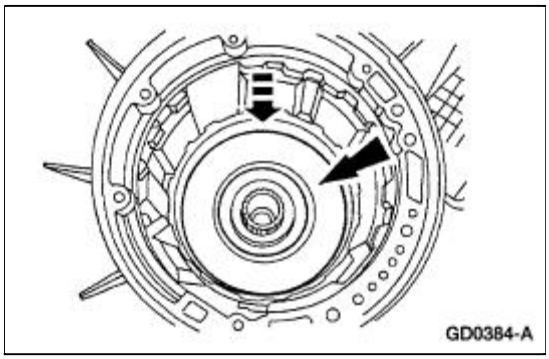


11. Install the center support retaining ring.

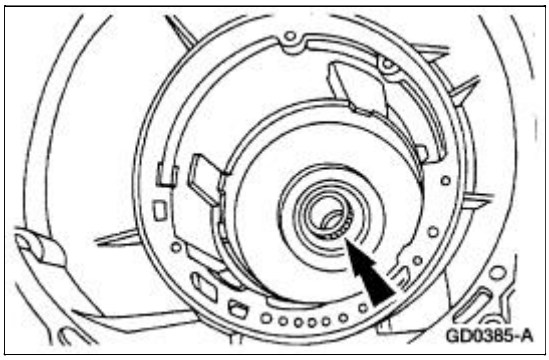
    - Reference the retaining ring tabs to the band anchor pin location.



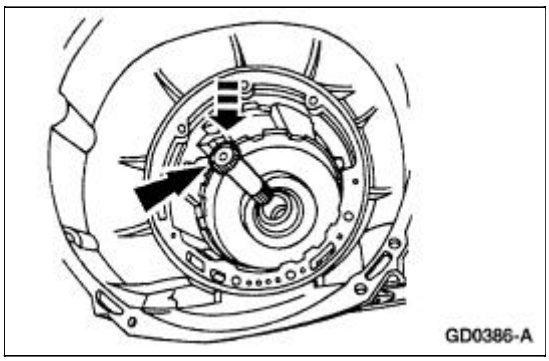
12. Install the forward clutch sun gear, the No. 5 forward clutch sun gear bearing and the reverse sun gear.



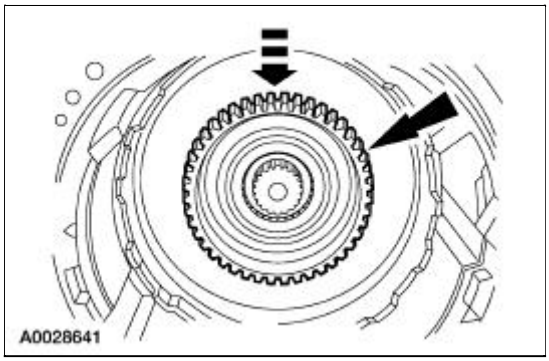
13. Install the No. 4 forward clutch hub bearing.



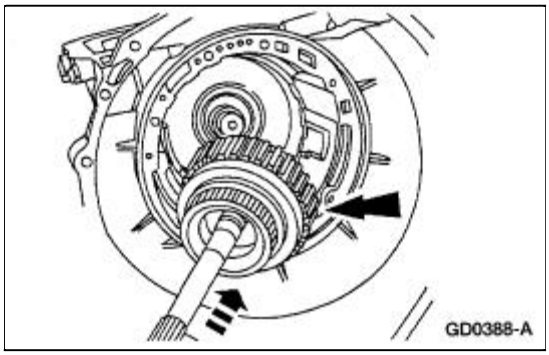
14. Install the intermediate stub shaft.



15. Install the forward clutch hub and the No. 3 forward clutch hub front bearing.

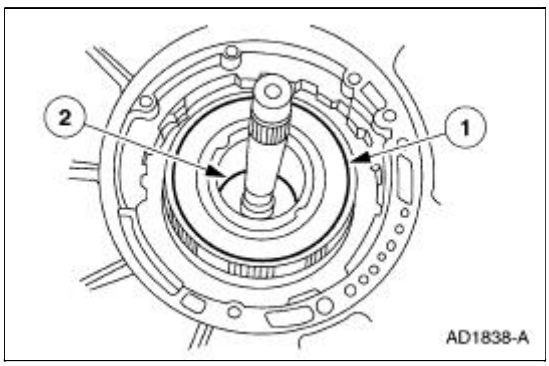


16. Install the forward clutch assembly.

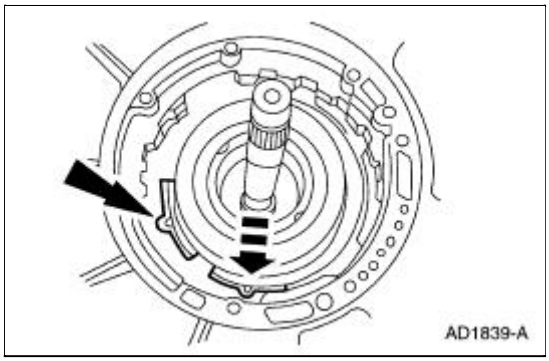


17. **NOTE:** Make sure the reverse clutch cylinder lugs are completely seated in the notches of the reverse sun gear.

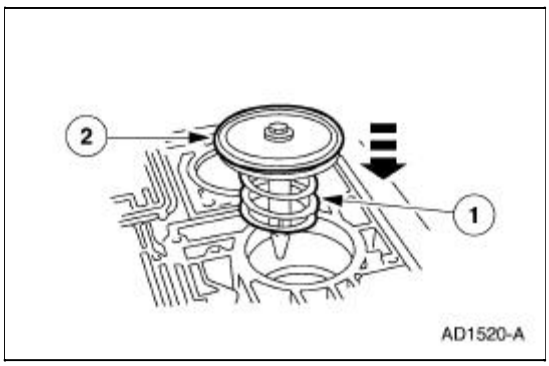
    Install the reverse clutch cylinder assembly.
    1. Install the reverse clutch cylinder.
    2. Install the No. 2 forward clutch bearing.



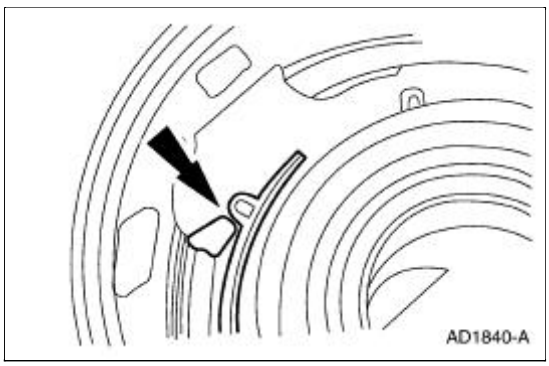
18. Install the overdrive band.
    - Position the overdrive band pocket onto the anchor pin.



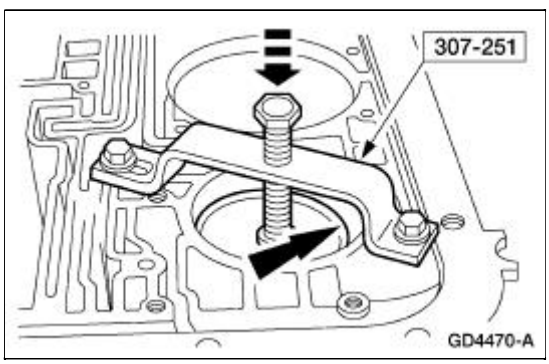
19. Install the overdrive servo spring.
    1. Install the overdrive servo piston return spring.
    2. Install the overdrive servo piston.



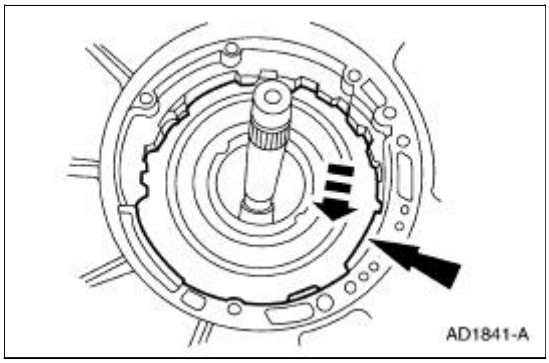
20. Verify the tip of the piston assembly engages the pocket of the overdrive band.



21. Using the special tool, compress the overdrive servo assembly and install the overdrive servo retaining ring.

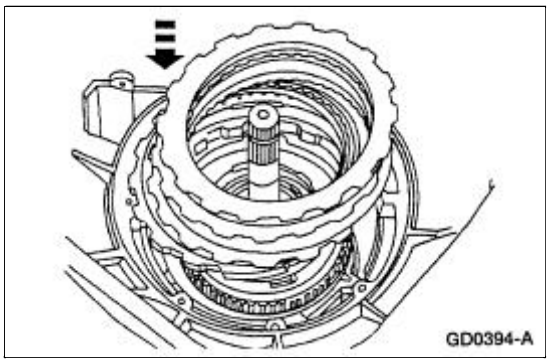


22. Install the intermediate clutch pressure plate.



23. **NOTE:** Before assembly, soak the new clutch discs in clean automatic transmission fluid for 15 minutes.

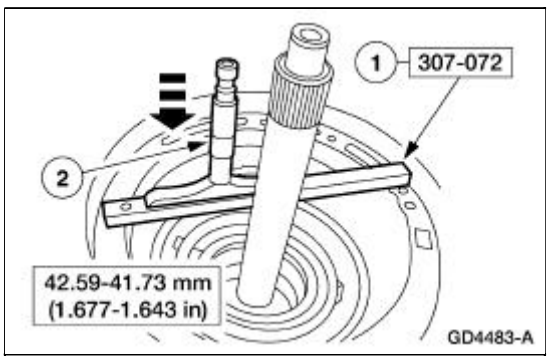
    Install the intermediate clutch pack and selective steel plate.



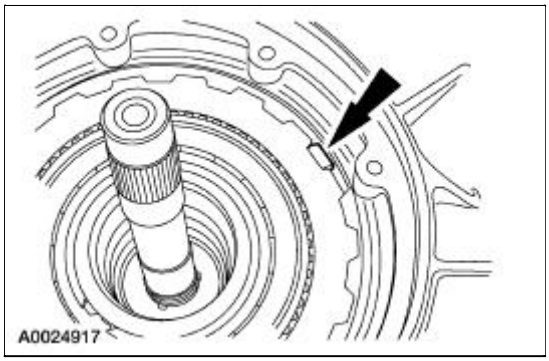
24. Using the special tool, check the intermediate clutch clearance.
    1. Position the special tool on the pump case mounting surface.
    2. Maintaining downward pressure, use a depth micrometer to measure and verify intermediate clutch clearance is within specification.
       If the intermediate clutch is not within specification, install a correct selective plate.

Selective Steel Plates

Specification
1.80-1.70 mm (0.071-0.067 inch)
2.05-1.95 mm (0.081-0.077 inch)
2.31-2.20 mm (0.091-0.087 inch)
2.56-2.46 mm (0.101-0.097 inch)



25. Install the intermediate anti-rattle clip, if equipped.

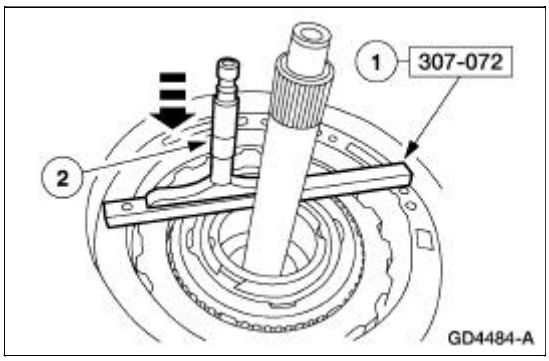


26. Using the special tool, measure end clearance for the No.1 front pump thrust washer.
    1. Position the special tool on the pump case mounting surface.
    2. Maintaining downward pressure, use a depth micrometer to measure end play clearance.

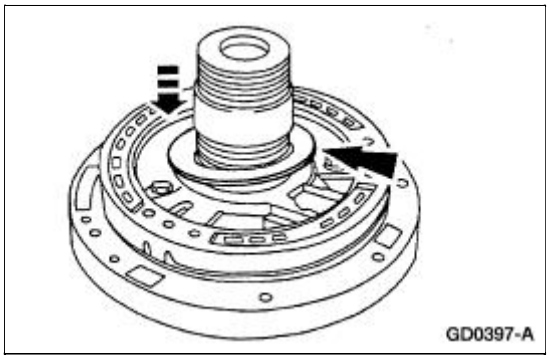
    Use the No.1 thrust washer chart to select the correct washer.

No.1 Thrust Washer Chart

Depth	Thickness	Color Code
37.706-38.184 mm (1.485-1.503 inch)	1.270-1.372 mm (0.050-0.054 inch)	Green
38.185-38.641 mm (1.504-1.521 inch)	1.727-1.829 mm (0.068-0.072 inch)	Yellow
38.642-39.073 mm (1.522-1.538 inch)	2.159-2.261 mm (0.085-0.089 inch)	Natural
39.074-39.505 mm (1.539-1.555 inch)	2.591-2.692 mm (0.102-0.106 inch)	Red
39.506-40.165 mm (1.556-1.581 inch)	3.023-3.124 mm (0.119-0.123 inch)	Blue

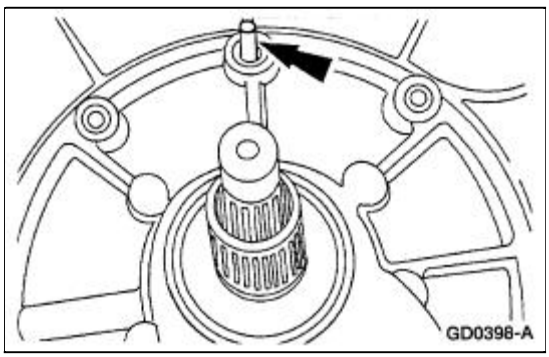


27. Install the No.1 front pump support thrust washer.
    - Use petroleum jelly to hold the washer in place.



28. **NOTE:** The alignment pin is a fabricated M8 x 1.25 mm (0.05 in) bolt with the head removed.

    Install an alignment pin at the top of the case.

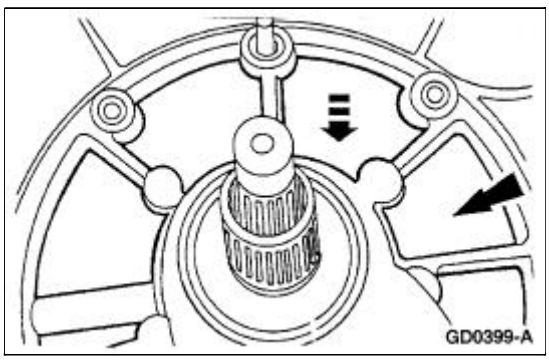


29. **NOTE:** Make sure the gasket is positioned correctly and the case passages are not covered.

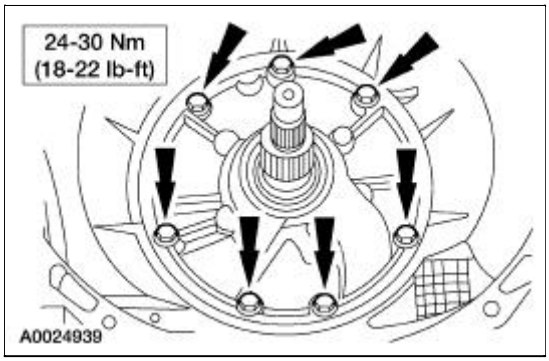
    Install the pump gasket.

30. **NOTE:** To aid assembly, shake the input shaft while pushing down on the pump.

    Install the pump assembly.

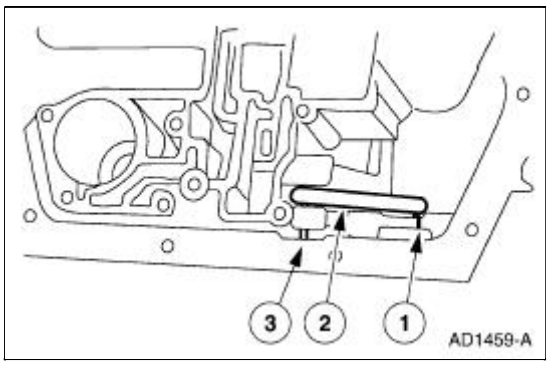


31. Remove the alignment pin and install the front pump bolts.
    - Alternate bolt tightening to set the pump.

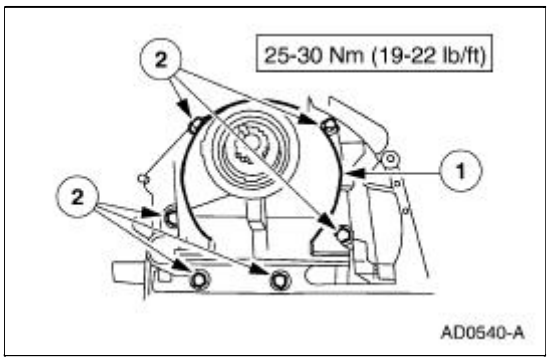


32. Rotate the transmission to the horizontal position.

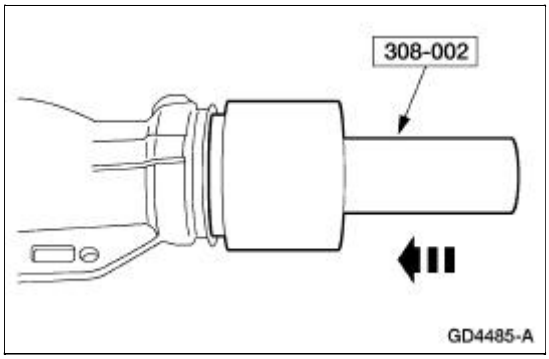
33. Install the parking pawl.
    1. Position the parking pawl return spring.
    2. Position the parking pawl.
    3. Install the parking pawl shaft.



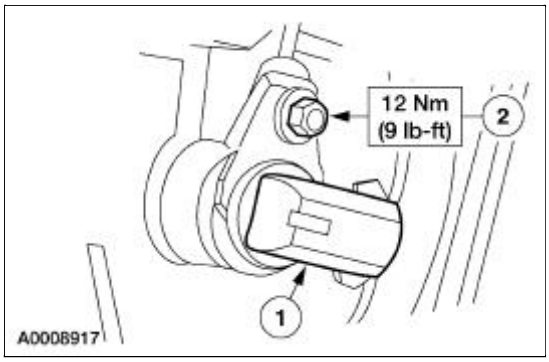
34. Install a new extension housing gasket and the extension housing.
    1. Position the extension housing.
    2. Install the four bolts and two nuts.



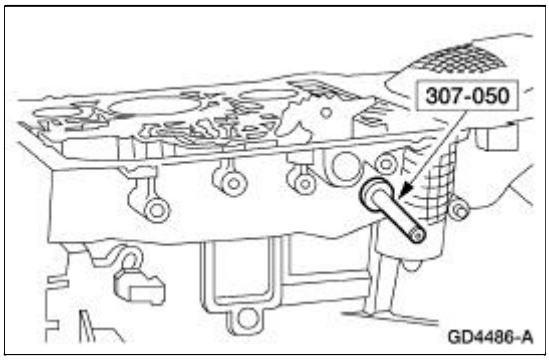
35. Using the special tool, install a new extension housing seal.



36. Install the output shaft speed (OSS) sensor.
    1. Position the OSS sensor.
    2. Install the bolt.

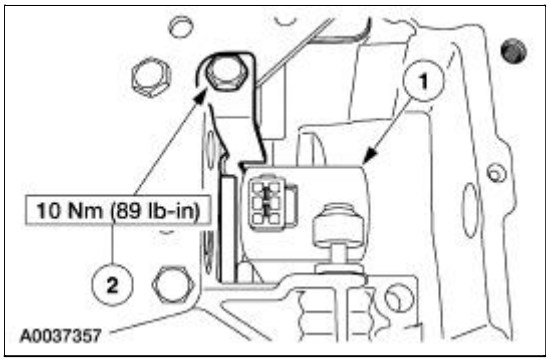


37. Using the special tool, install the manual control lever seal.

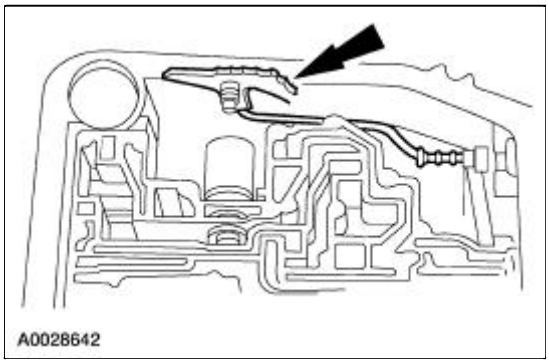


38. **NOTE:** Lubricate the electronic pressure control (EPC) solenoid O-rings with clean automatic transmission fluid.

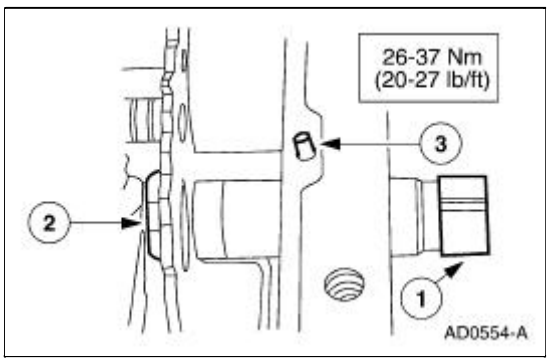
    Install the EPC solenoid.
    1. Install the EPC solenoid.
    2. Install the EPC solenoid bracket and bolt.



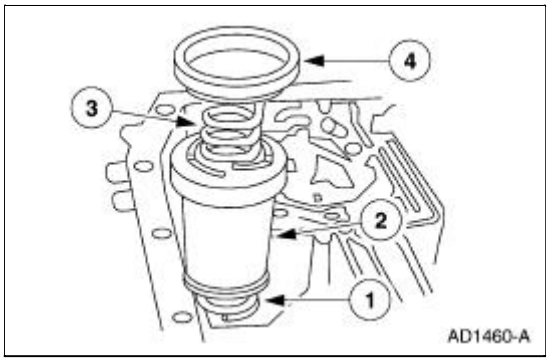
39. Install the manual valve detent lever and parking lever actuating rod.



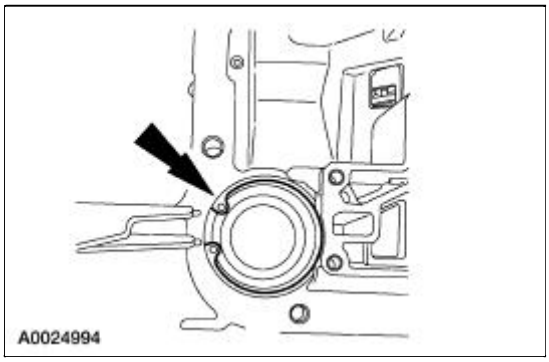
40. Install the manual control lever shaft.
    1. Slide the manual control shaft into the case.
    2. Install the manual lever shaft inner nut.
    3. Install the manual lever shaft retaining pin.



41. Install the 1-2 accumulator piston assembly.
    1. Install the 1-2 accumulator upper spring.
    2. Install the 1-2 accumulator.
    3. Install the 1-2 accumulator lower spring.
    4. Install the 1-2 accumulator cover and seal.



42. Install the 1-2 accumulator retaining ring.

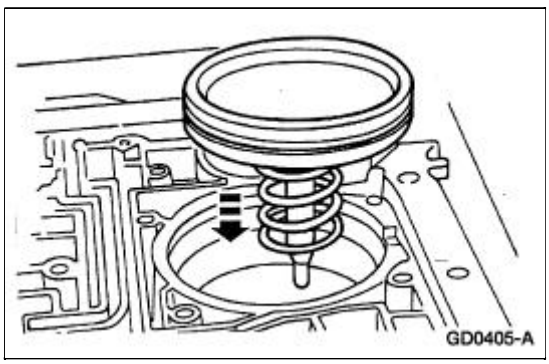


43. **NOTE:** This is not an ordinary installation procedure and does not compensate for band wear. When new piston and rod assembly installation becomes necessary, or when a new reverse band has been installed, the reverse piston and rod length must be adjusted.

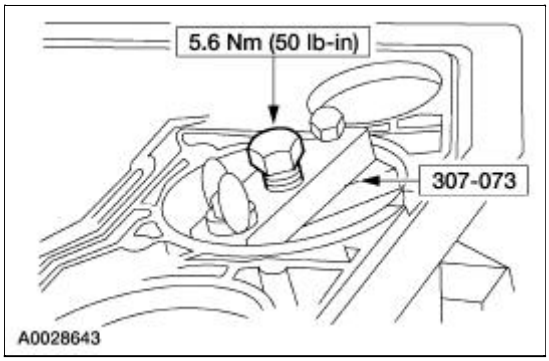
    NOTE: Lubricate the reverse piston seal to facilitate assembly and prevent damage to the seal.

    NOTE: Do not install the reverse servo piston cover and seal at this time.

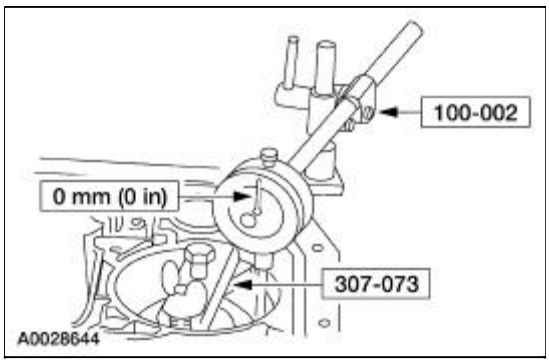
    Install the reverse servo piston and rod assembly.



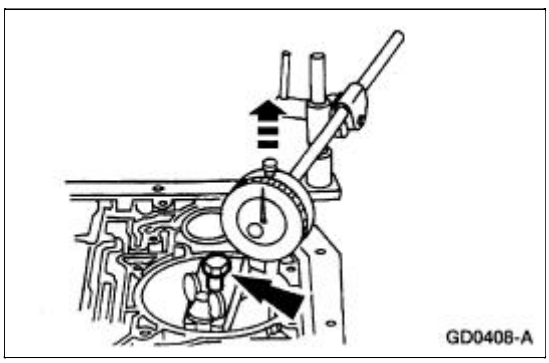
44. Install the special tool.
    - Tighten the bolt.



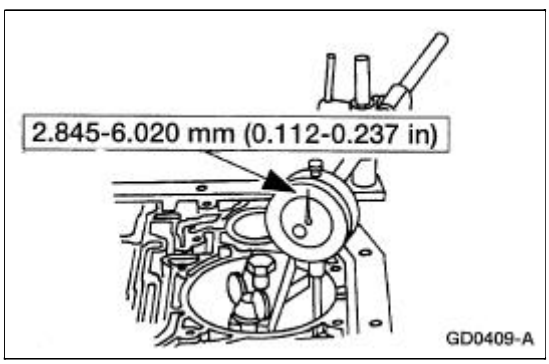
45. Install the special tool.
    - Position the indicator stem on the flat portion of the reverse servo piston and zero the dial indicator.



46. Loosen the bolt until the piston stops against the tool.

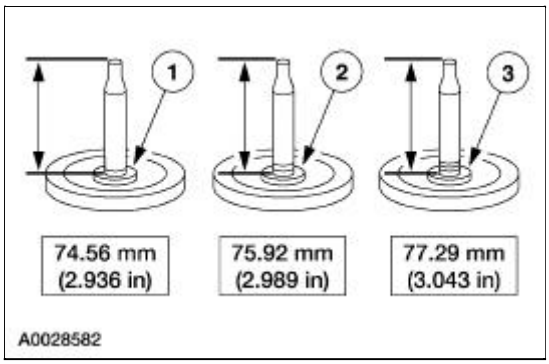


47. Verify that the amount of piston travel on the dial indicator is within specification.

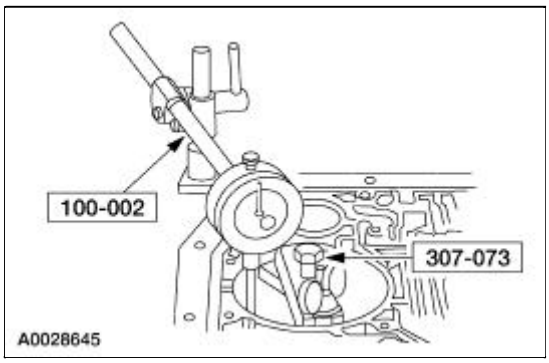


48. If piston travel is not within specification, select and install the correct servo assembly to bring the servo piston travel within specification.

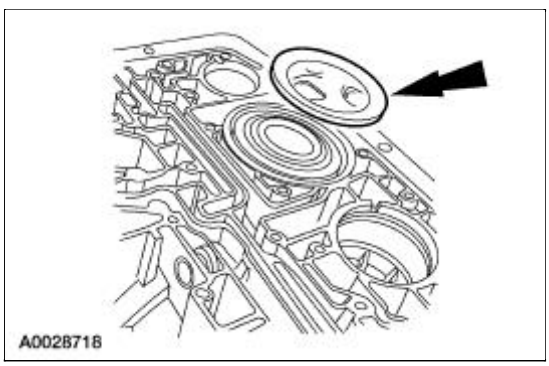
1. One groove
2. Two grooves
3. Three grooves



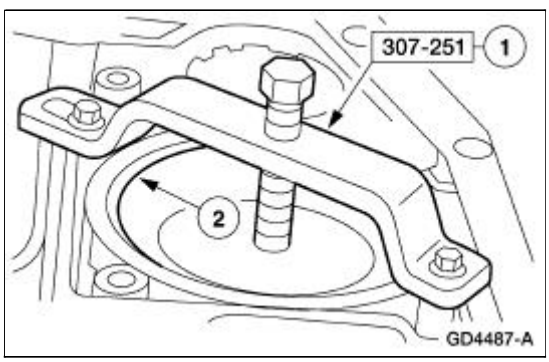
49. Remove the special tools.



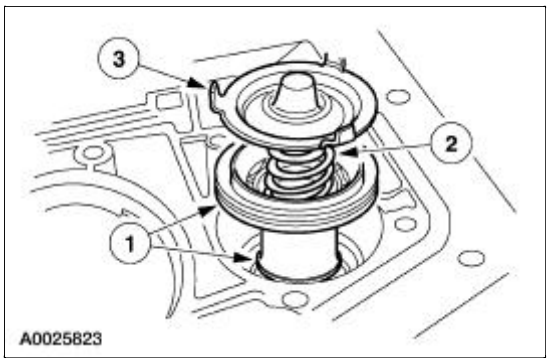
50. Install the reverse servo piston cover and seal assembly.



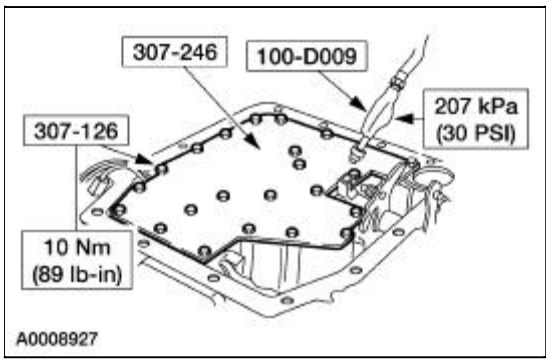
51. Using the special tool, install the reverse servo retaining ring.
    1. Compress the reverse band servo.
    2. Install the reverse band servo retaining ring.



52. Install the 2-3 accumulator assembly.
    1. Install the accumulator piston.
    2. Install the accumulator piston spring.
    3. Install the accumulator spring retainer.

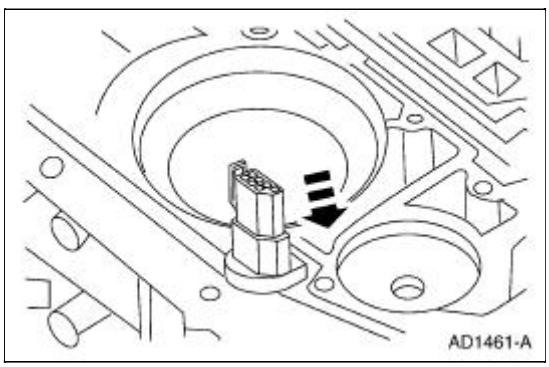


53. Using the special tools apply regulated air pressure to the test ports. Verify that the components are applied and released.



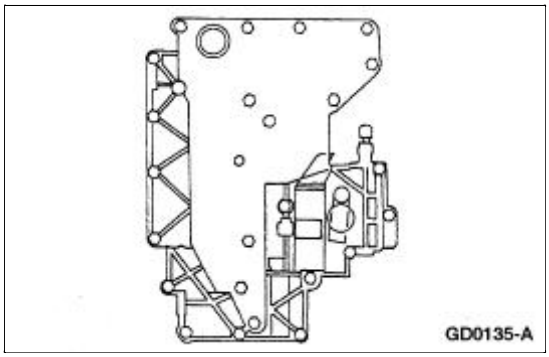
54. **NOTE:** The tab on the electrical connector is secured by main control valve body.

    Install the electrical connector into the case.



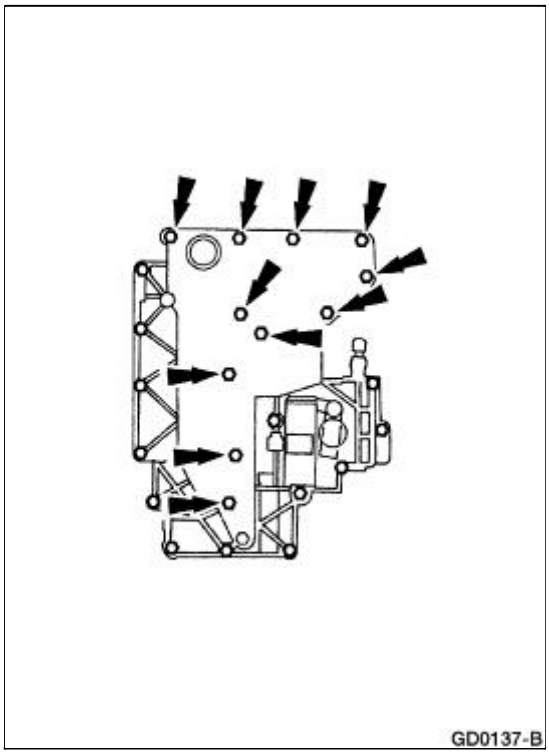
55. **NOTE:** The alignment bolts are valve body assembly bolts and are in the valve body.

    Align the main control valve body alignment bolts and position the main control valve body.



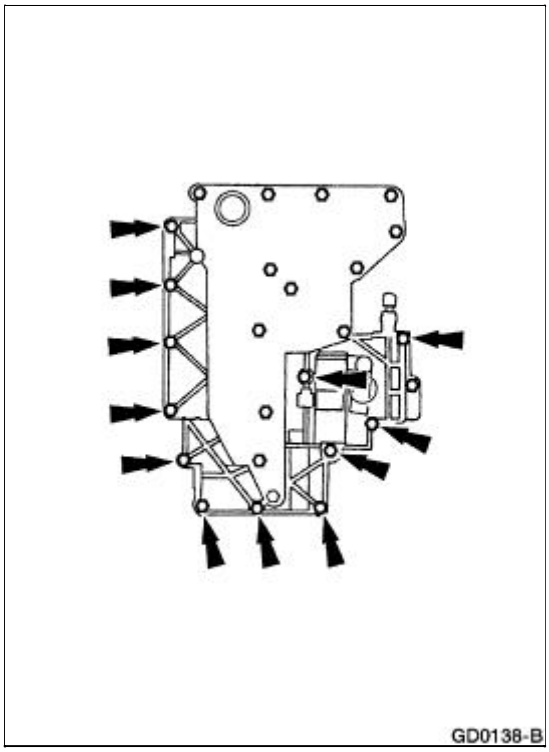
56. **NOTE:** The main control valve body bolts will be tightened in later steps.

    Loosely install the 11 long main control valve body bolts.

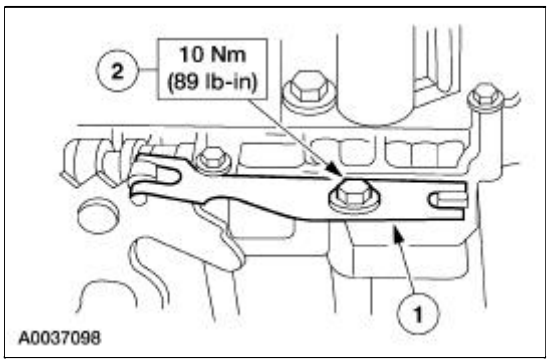


57. **NOTE:** The main control valve body bolts will be tightened in later steps.

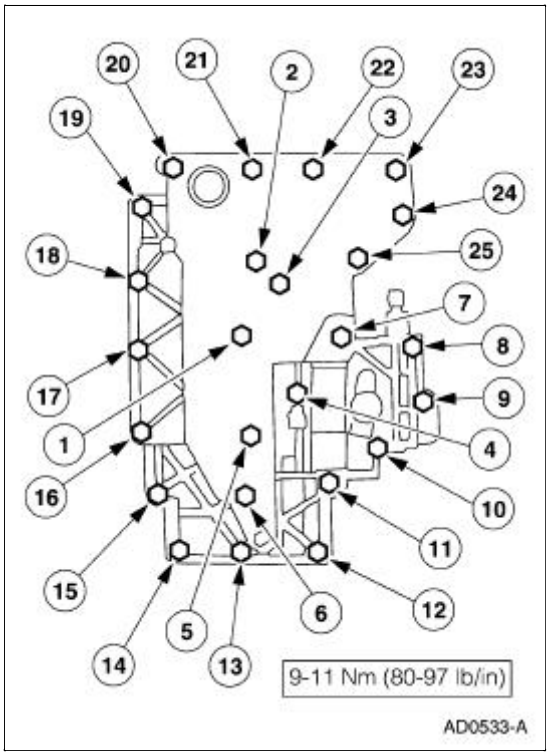
    Loosely install the 12 short main control valve body bolts.



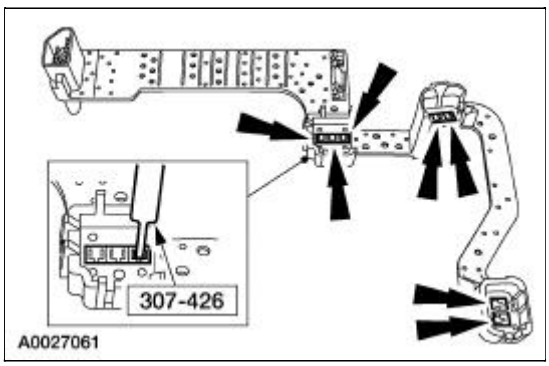
58. Install the manual control valve detent lever spring.
    1. Position the manual control valve detent lever spring.
    2. Install the bolt.



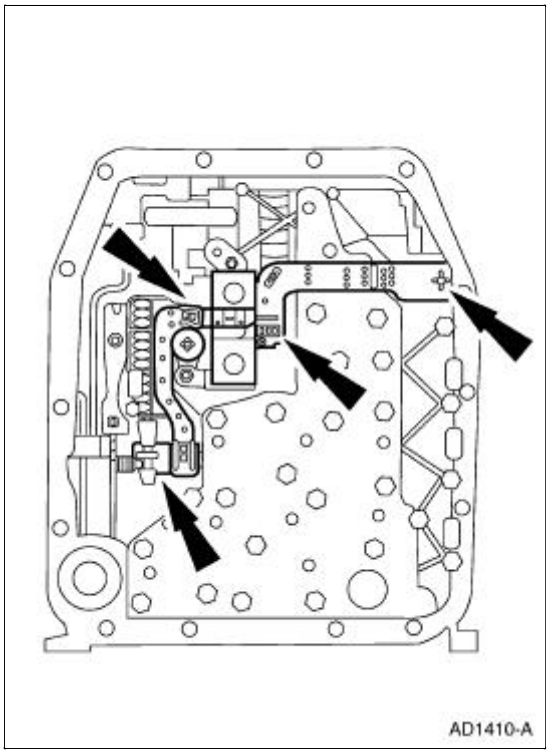
59. Tighten the bolts in the sequence shown.



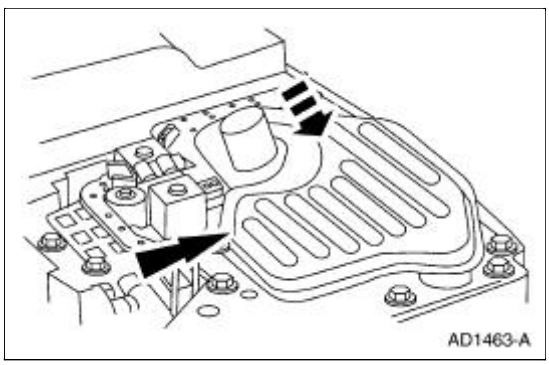
60. Inspect the lead frame for damage.
    - Using the special tool, check all the lead frame solenoid connections. The gauge should fit tightly and not fall out after being inserted.
    - If the special tool passes through any lead frame connector pins or does not feel like it makes a good contact, install a new lead frame.



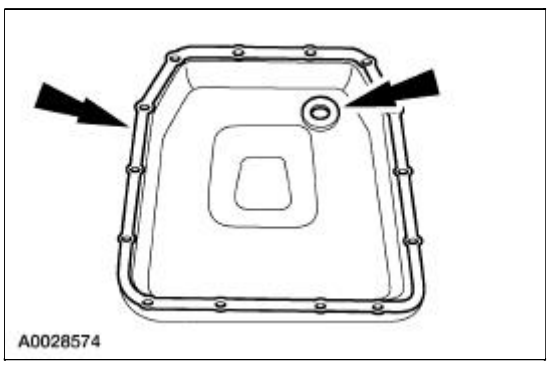
61. Connect the molded lead frame to the solenoids.
    - Connect the bulkhead inter-connector by pressing it in place by hand and fully seating the connector in place.
    - Connect the EPC solenoid by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.
    - Connect the TCC by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.
    - Connect the shift solenoid SSA and SSB by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.



62. Install the fluid filter and seal assembly.

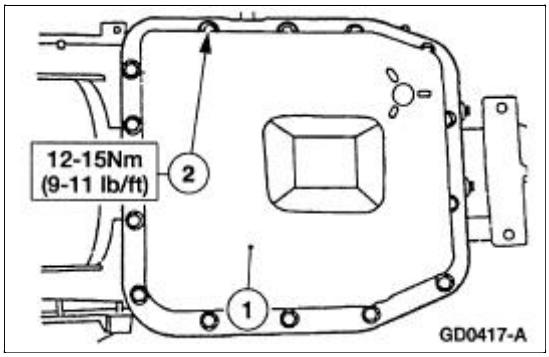


63. Position the pan magnet onto the fluid pan.

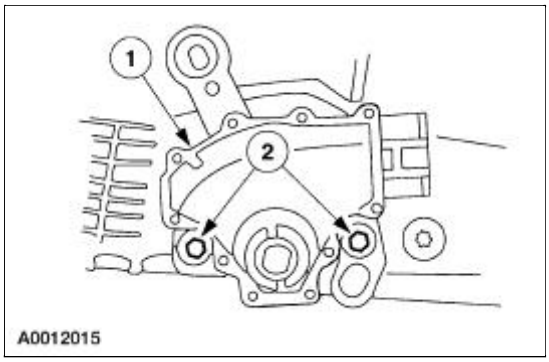


64. **NOTE:** The pan gasket is reusable; clean and inspect for damage. If not damaged, the gasket should be reused.

    Install the fluid pan.
    1. Position the transmission fluid pan.
    2. Install the 14 transmission fluid pan bolts.



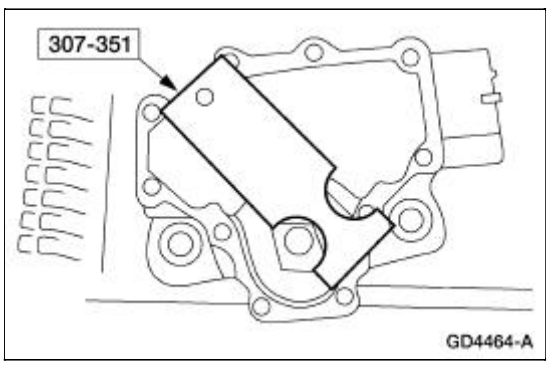
65. Install the digital transmission range (TR) sensor.
    1. Install the digital TR sensor.
    2. Loosely install the digital TR bolts.



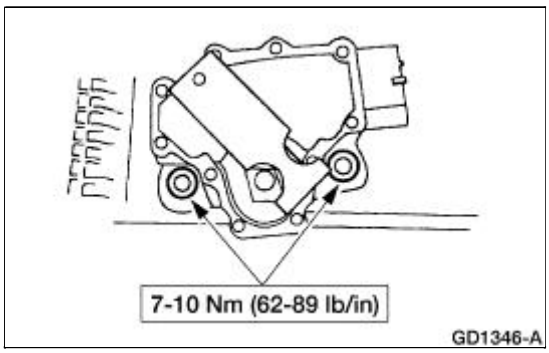
66. **NOTE:** The tool is designed to fit snugly.

    NOTE: Manual shift lever must be in the neutral position.

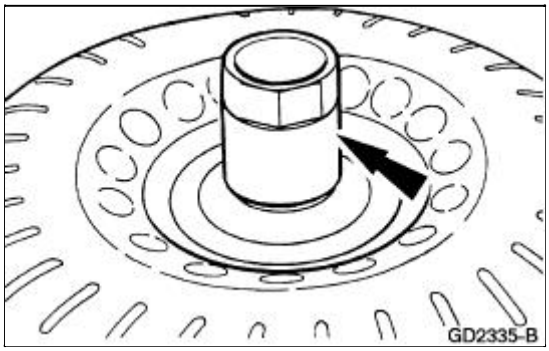
    Using the special tool, align the digital TR sensor slots.



67. Tighten the bolts.



68. Lightly lubricate the converter hub with clean automatic transmission fluid.

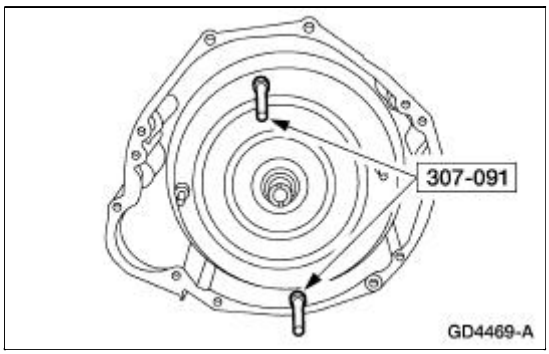


69. **WARNING: The torque converter can fall out if the transmission is tipped.**

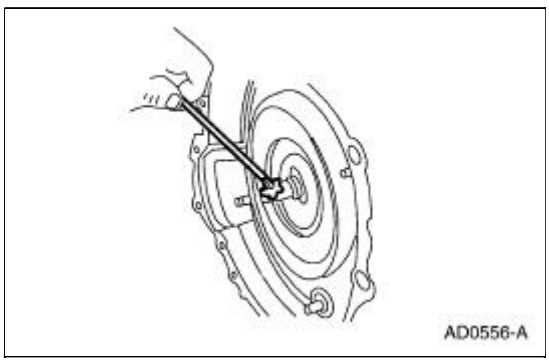
CAUTION: Make sure the converter hub is fully engaged in the front pump support and gear and rotates freely. Do not damage the hub seal.

CAUTION: If the torque converter slides out, the hub seal may be damaged.

Using the special tools, install the torque converter.



70. Lubricate the torque converter pilot hub with multi-purpose grease.



Transmission

Special Tool(s)

ST1636-A	Retainer, Torque Converter 307-346 (T97T-7902-A)

Material

Item	Specification
Multi-Purpose Grease D0AZ-19584-AA	ESB-M1C93-B
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

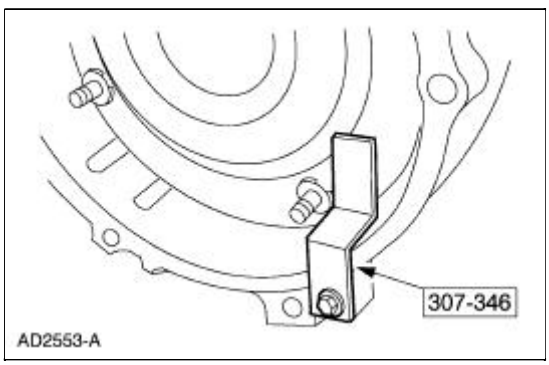
1. **CAUTION: During this move, to avoid damage, do not allow the transmission to get into a nose-down position as this will cause the torque converter to move forward and disengage from the pump gear. The converter housing is piloted into position by dowels in the rear of the engine block. The torque converter must rest squarely against the flexplate. This indicates that the converter pilot is not binding in the engine crankshaft.**

   Position and secure the transmission on the high-lift transmission jack.

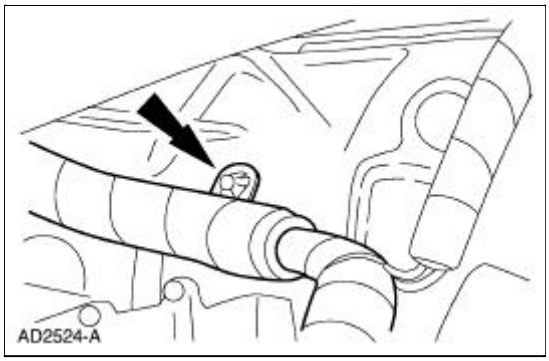
2. **CAUTION: Make sure the torque converter is fully seated in the transmission before positioning the transmission to the engine.**

   Using the special tool, install the transmission to the engine.

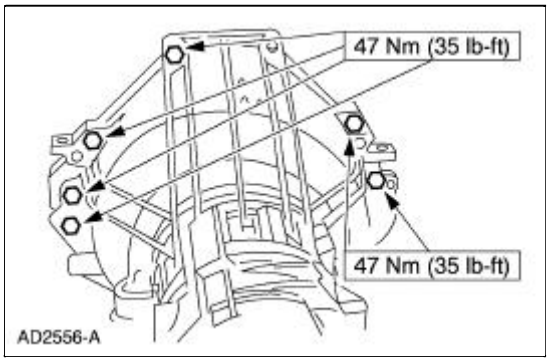
   - Align the orange balancing marks on the converter stud and the flexplate bolt hole.



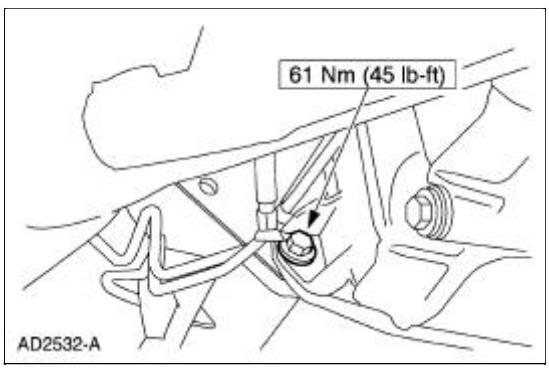
3. Reconnect the harness.



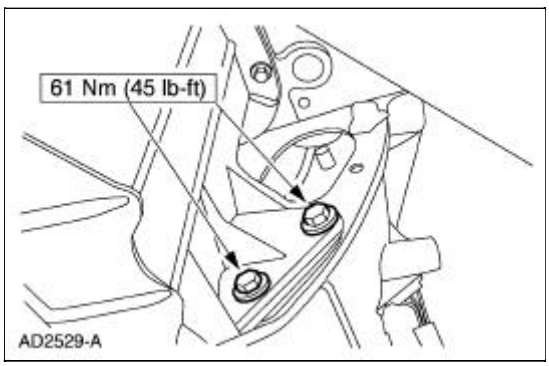
4. Install the bolts.



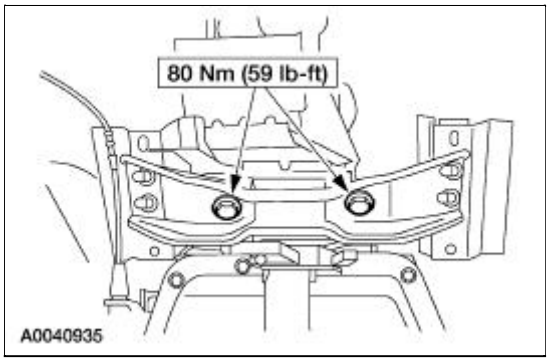
5. Install the bolt.



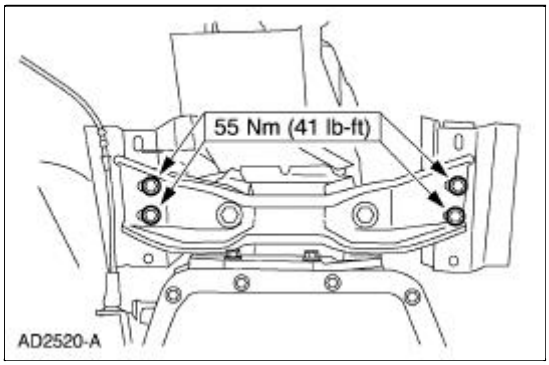
6. Install the bolts.



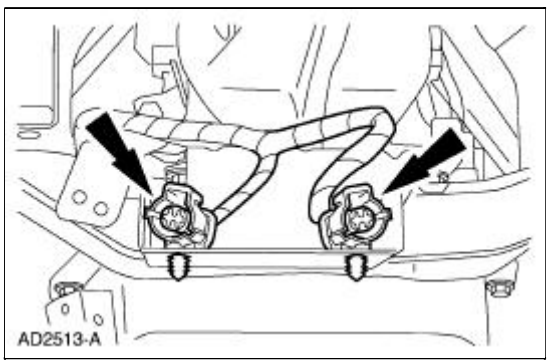
7. Install the bolts.



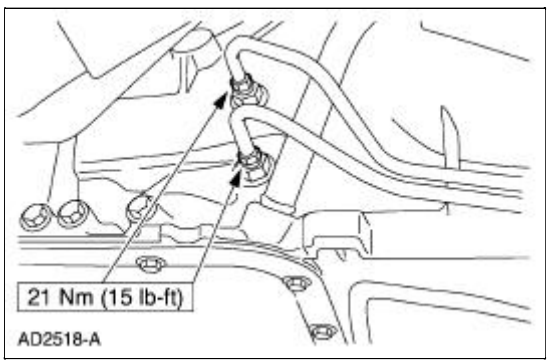
8. Install the bolts.



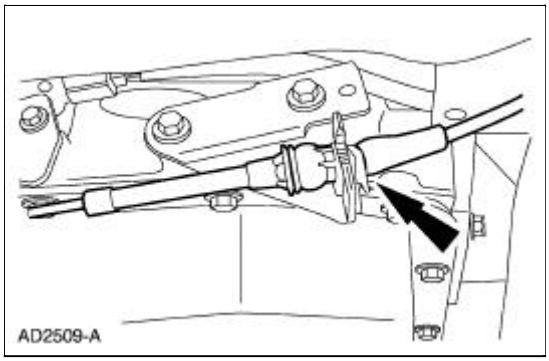
9. Reconnect the connectors.



10. Connect the transmission fluid cooler tubes.

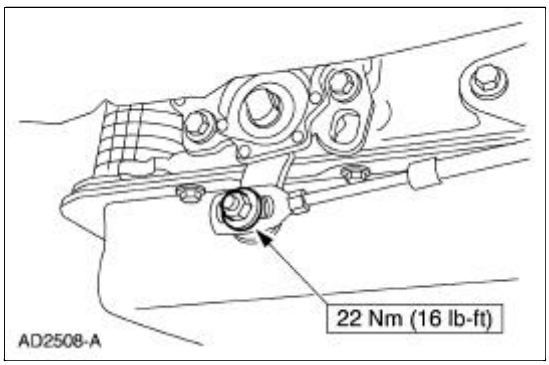


11. Install the shift cable.

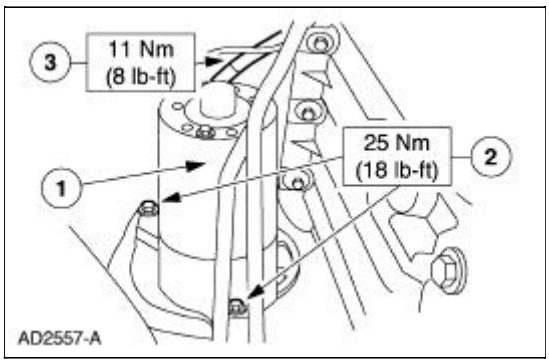


12. **NOTE:** The manual lever must be in the overdrive position.

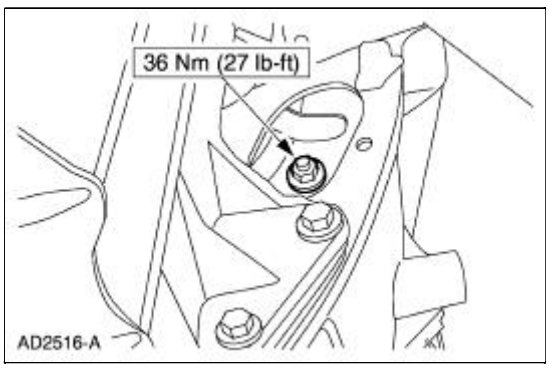
    Connect the shift cable at the manual lever.



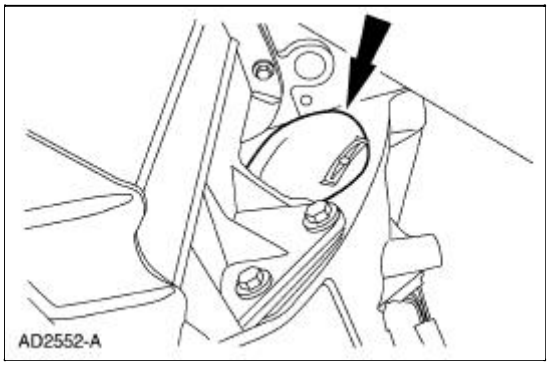
13. Install the starter.
    1. Position the starter.
    2. Install the bolts.
    3. Connect the wires.



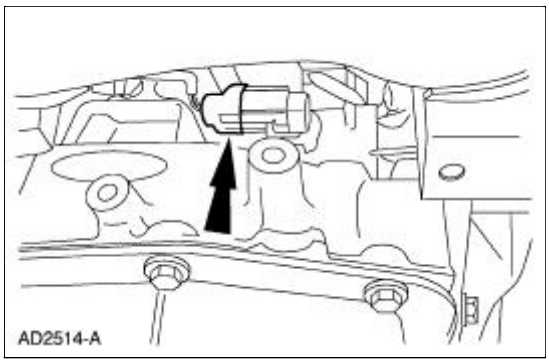
14. Install the four nuts.



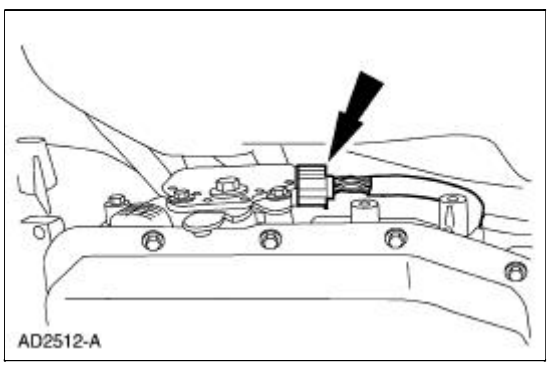
15. Install the cover.



16. Reconnect the connector.



17. Reconnect the connector.

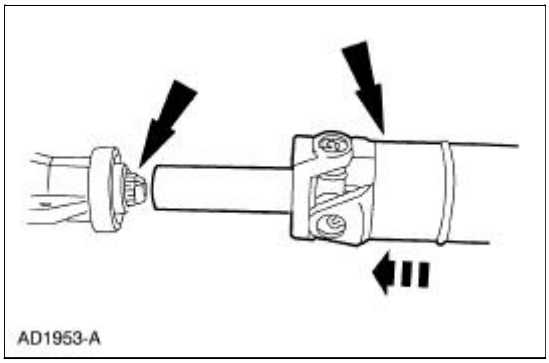


18. Install the dual converter Y pipe.

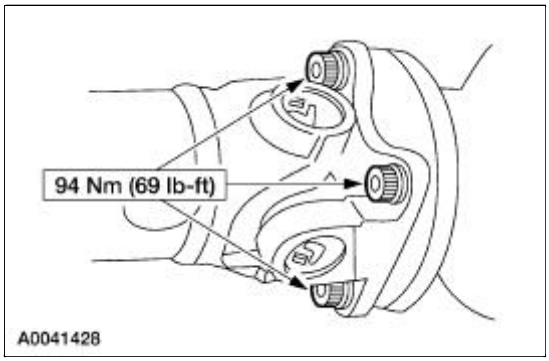
19. **NOTE:** The output shaft and the drive shaft are a balanced assembly.

    Install the driveshaft.

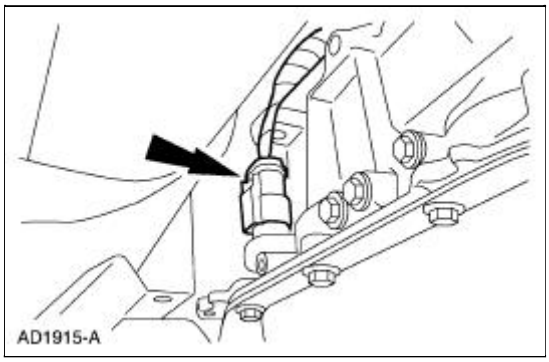
    - Align the yellow dots and position the driveshaft on the transmission.
    - Position the driveshaft to the rear differential.



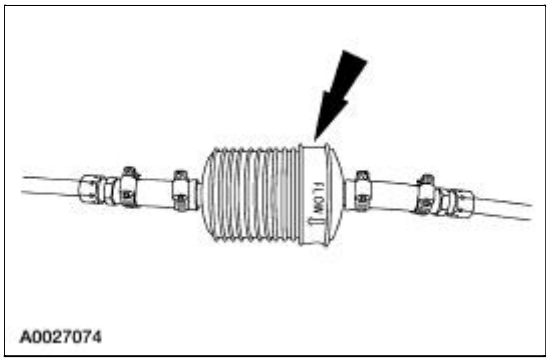
20. Install the bolts.



21. Connect the connector.



22. Use the following guidelines for the in-line transmission fluid filter:
    - If the transmission was overhauled and the vehicle was equipped with an in-line fluid filter, install a new in-line fluid filter.
    - If the transmission was overhauled and the vehicle was not equipped with an in-line fluid filter, install a new in-line fluid filter kit.
    - If the transmission is being installed for a non-internal repair, do not install an in-line filter or filter kit.
    - If installing a Ford authorized remanufactured transmission, install the in-line transmission fluid filter that is supplied.
      Prior to lowering the vehicle, install a new in-line transmission filter or a filter kit.



23. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more until the vehicle relearns the strategy.

    Connect the battery ground cable.

24. If required, fill the transmission with clean automatic transmission fluid.

25. Check the transmission for correct operation.